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EDITED BY J. McKEEN CATTELL

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A Remarkable Textbook

Barber's First Course in General Science

By FREDERICK D. BARBER, Professor of Physics in the Illinois State Normal University, MERTON L. FULLER, Lecturer on Meteorology in the Bradley Polytechnic Institute, JOHN L. PRICER, Professor of Biology in the Illinois State Normal University, and HOWARD W. ADAMS, Professor of Chemistry in the same. vii+588 pp. of text. 12mo. $1.25.

A recent notable endorsement of this book occurred in Minneapolis. A Committee on General Science, representing each High School in the city, was asked to outline a course in Science for first year High School. After making the outline they considered the textbook situation. In this regard, the Committee reports as follows:

"We feel that, in Science, a book for first year High School use should be simple in language, should begin without presupposing too much knowledge on the part of the student, should have an abundance of good pictures and plenty of material to choose from.

Barber's *First Course in General Science* seems to us to best meet these requirements and in addition it suggests materials for home experiments requiring no unusual apparatus, and requires no scientific measurements during the course. We recommend its adoption."

Other Interesting Opinions on the Book Follow:

SCHOOL SCIENCE AND MATHEMATICS:—It is one of the very best books on general science that have ever been published. The biological as well as the physical side of the subject is treated with great fairness. There is more material in the text than can be well used in one year's work on the subject. This is, however, a good fault, as it gives the instructor a wide range of subjects. The book is written in a style which will at once command not only the attention of the teacher, but that of the pupil as well. It is interesting from cover to cover. Many new and ingenious features are presented. The drawings and halftones have been selected for the purpose of illustrating points in the text, as well as for the purpose of attracting the pupil and holding his attention. There are 375 of these illustrations. There is no end to the good things which might be said concerning this volume, and the advice of the writer to any school board about to adopt a text in general science is to become thoroughly familiar with this book before making a final decision.

WALTER BARR, *Keokuk, Iowa:*—Today when I showed Barber's Science to the manager and department heads of the Mississippi River Power Co., including probably the best engineers of America possible to assemble accidentally as a group, the exclamation around the table was: "If we only could have had a book like this when we were in school." Something similar in my own mind caused me to determine to give the book to my own son altho he is in only the eighth grade.

G. M. WILSON, *Iowa State College:*—I have not been particularly favorable to the general science idea, but I am satisfied now that this was due to the kind of texts which came to my attention and the way it happened to be handled in places where I had knowledge of its teaching. I am satisfied that Professor Barber, in this volume, has the work started on the right idea. It is meant to be useful, practical material closely connected with explanation of every day affairs. It seems to me an unusual contribution along this line. It will mean, of course, that others will follow, and that we may hope to have general science work put on such a practical basis that it will win a permanent place in the schools.

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MAY, 1917

THE FUR-SEALS OF THE PRIBILOF ISLANDS

By Professor G. H. Parker
Harvard University

IT has often been said that more legislation has been devoted to the northern fur-seal than to any other animal. So far as the United States is concerned, this statement is not surprising, for the revenue that has been derived from these animals since 1867 when our government acquired possession of their principal breeding place, the Pribilof Islands, has been more than ten millions of dollars. This large sum does not represent all pure gain, but the profits included in it must have gone a long way toward meeting the seven million dollars and more that the United States paid Russia for the whole of Alaska including the Pribilofs. And, if the Alaskan account is not already settled by the past income from the seals, it can be so discharged with a very little care. Of all the treasures in Alaska, the seals are probably among the most valuable. Unlike mineral wealth, they need never run out, for, in consequence of their powers of reproduction, they can yield under reasonable control a large and continuous revenue for an indefinite future. It is therefore easy to understand the unusual occasion for legislative activity in behalf of these animals and indeed any government would be most negligent of its interests did it not exert itself to the utmost to maintain and improve so valuable a source of income.

The popular idea of seals comes mostly from the hair-seals which are common in the harbors and along the shores of many countries. These animals are noted for their agility in the water, but on land they are clumsy and awkward. The fur-seals are not closely allied to the hair-seals, but find their nearest relatives in the sea-lions, whose skill on land is often attested by their remarkable acrobatic performances in zoological gardens and even on the stage. The fur-seal, though apparently not so skilful as the sea-lion, is thoroughly at home on land and walks and runs like a short-legged bear. Hence it has often been called the sea-bear. It is also a most skilful and adroit swimmer.

The fur-seals of the North Pacific are represented at present by three herds (Fig. 1). A small one of perhaps ten to twelve thousand

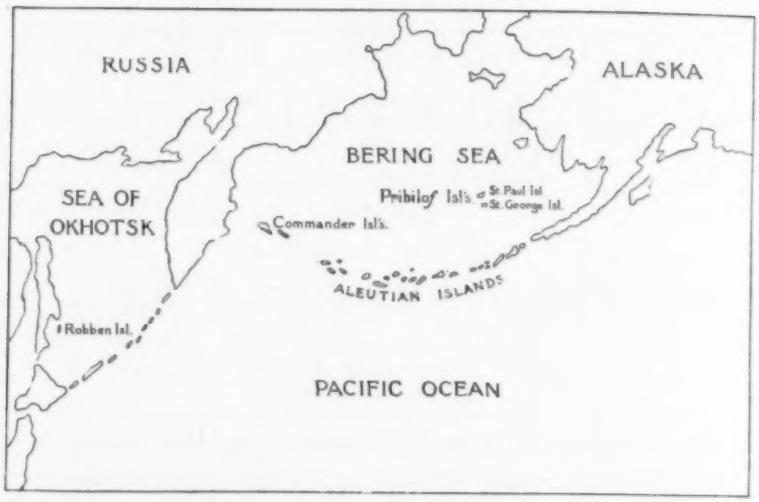

FIG. 1. OUTLINE MAP OF THE NORTH PACIFIC AND BERING SEA, showing the locations of the breeding grounds of the three fur-seal herds: Robben Island, the Commander Islands, and the Pribilof Islands.

individuals breeds on Robben Island in the Sea of Okhotsk and is supposed to have a migration route in the Sea of Japan. This herd is now under Japanese management. A second and larger herd breeds on the Commander Islands west of the Aleutian chain. These seals are said to migrate along the eastern coast of Japan and are under the control of Russia. By far the largest herd is that which breeds on the Pribilof Islands. Its winter migration route lies southward through the passes of the Aleutian Islands into the Northern Pacific with a return route along the west coast of North America. This herd is under the management of the United States. All three herds are supposed to be quite distinct and not to mingle in their migrations. Each probably represents a distinct species.

The discovery of these seal herds is due to the early Russian naviga-

FIG. 2. OUTLINE MAP OF ST. GEORGE ISLAND, showing the location of its four fur-seal rookeries.

FIG. 3. OUTLINE MAP OF ST. PAUL ISLAND, showing the locations of its twelve fur-seal rookeries.

tors. Late in the year 1741 Bering, in returning from his second voyage to the North Pacific, with a crew sick and much reduced, reached the Commander Islands rather by good fortune than by good seamanship. On the island subsequently named for him the expedition was forced to winter. Here scurvy still further reduced the crew, and among those who died was Bering himself. In the following spring, Steller, the naturalist of the expedition, reorganized the party for its return, but, before its departure, the arrival of the fur-seals took place and thus was disclosed to Steller the breeding haunt of what has ever since been the chief body of the Russian herd. Later navigators, in their explorations of the Aleutian chain, tried to follow the fur-seals that were seen in migration in the passes of these islands and thus to discover their breeding places. But none of these efforts were successful till 1786 when Pribilof made his way through the mists and fogs of Bering Sea to Saint George Island, where he came upon the hosts of fur-seals that breed on its shores. Although only forty miles distant and under a clear sky easily visible from Saint George, the larger and richer island of Saint Paul was not discovered till a year later, a fair commentary on the prevailing weather of this region. Thus the two great seal islands of Bering Sea were thrown open a little over a century and a quarter ago to the Russian traders. With our purchase of Alaska from Russia in 1867 these islands became a part of the United States.

Both islands are of volcanic origin, though at present no active volcanoes or even hot springs are found upon them. Their general surface is composed of lava rock, boulders and volcanic sands. There are no trees upon them, but in the short summer they are covered with a coarse, luxuriant tundra growth. Neither island has a good harbor and the weather is often so tempestuous that they afford practically no lee to vessels. Saint Paul is a succession of low rolling hills. Saint George is more precipitous, some of the cliffs on the shore rising to a height of a thousand feet or more. Saint Paul is a little over thirteen miles in total length and Saint George not above twelve. Yet these two islands whose total area is not so much as eighty square miles have yielded the unusual revenue already noted. Who can tell what the rest of Alaska with an area of more than half a million square miles may yield?

When first discovered the islands of Saint George and Saint Paul were without human inhabitants. The Russians, however, soon brought to their shores as a means of carrying on the seal industry a number of Aleut Indians and these intermarrying with the Russians gave rise to the present so-called native population. These natives are gathered together in a village on each island. In 1914 the village of Saint George contained 116 natives distributed in twenty-four households and

FIG. 4. MATURE BULL IN PRIME CONDITION AWAITING THE ARRIVAL OF THE COWS. Kitovi Rookery, June 22, 1914.

the village of Saint Paul 192 natives in fifty households. Besides the natives, each village contains a few whites: a government agent, doctor, school-teacher, store-keeper, radio-operator and the like. But interesting and commercially important as the natives are and fascinating as are the herds of reindeer, foxes, and sea-lions, and the great bird rookeries of the Pribilofs, none of these can compare with the long stretches of beach occupied by thousands upon thousands of fur-seals. Indeed it is highly improbable that there exists anywhere else on the surface of the globe such a huge exhibition of mammalian life as on the shores of these islands.

A strange terminology has grown up in the description of the fur-seals. Full-grown male fur-seals are called bulls and the mature females cows. Their offspring are known as pups. The young males before sexual maturity are termed bachelors. A bull with his assem-

FIG. 5. WAITING BULLS ON SIVUTCH ROOKERY, June 29, 1914.

blage of cows is called a harem and a succession of harems on a beach constitutes a rookery. Strange and incongruous as this usage may seem, the individual terms when taken in relation to the particular aspect of the herd to which they refer are found to be descriptively most appropriate, and the observer in spite of his sense of the proprieties of language is brought quickly to adopt them.

The seals do not locate indiscriminately on the beaches of the Pribilofs, but repair year after year with great regularity to particular stretches, the so-called rookeries. Judging from the conditions of the shores and the declarations of the natives, these rookeries have been remarkably constant for many years past. They still retain for the most part the Russian names that were given them in the early days of their discovery. At Saint George four such rookeries can be distinguished (Fig. 2). On the shore of the island near the village are East

FIG. 6. TWO COWS WITH BULL. Probably Gorbatch Rookery, late in June, 1914.

Rookery, more or less subdivided, North Rookery, and Staraya Artel, probably indicating, as the Russian name implies, the location of one of the original settlements. Across the island from the village is Zapadni or the West Rookery. On Saint Paul there are no fewer than a dozen active rookeries (Fig. 3). At Northeast Point are Vostochni or East Rookery, and Morjovi or Walrus Rookery. Polovina or Halfway Rookery is between Northeast Point and the village of Saint Paul. Not far to the northeast from the village itself are Lukanin Rookery and Kitovi Rookery. To the south and southwest of these are Reef Rookery, Sivutch Rookery on Sea-lion Rock, and Ardiguen and Gorbatch rookeries. North from the village is the small Lagoon Rookery.

FIG. 7. A HAREM ON GORBATCH ROOKERY; the bull with many cows and new-born pups. July, 1914.

And on either side of English Bay are Tolstoi Rookery and the more or less divided Zapadni or West Rookery. It is on these situations, and not on the beaches in general, that the fur-seals congregate in enormous numbers for their breeding season. In consequence the rocks in these regions have become worn and smoothed so that even in the absence of seals a rookery site can be distinguished from that of an ordinary beach.

During the late winter all the fur-seals are at sea, but as summer approaches they migrate toward the Pribilofs, and in favorable seasons they begin to appear on the island rookeries as early as April. The first to come are the adult males or bulls (Fig. 4). The few that may appear in April take their places on the beaches and are quickly followed in May and the early part of June by the remainder of their kind. By the middle of June the great majority of the full-grown bulls have established themselves on the beaches to await the coming of the cows (Fig. 5). At this stage the bulls are in marvelous form. Their pelts are heavy and firm and their bodies in prime condition. In weight they are not far from 400 pounds. They seem to be possessed of inexhaustible energy. They will charge any intruder, man or beast, and drive him from their preserves. They move with a curious loping gait which may be about as fast as a man can run over a rough beach. After fifty to a hundred feet of such travel they usually desist, apparently from lack of wind. Their object at this season seems to be to defend their chosen territory from invasion, and this they will do to the bitter end. It is practically impossible for a human being to dislodge them and if another bull opposes them, they will slash him over the head, breast and fore flippers with their protruding canines till the blood and fur fly in all directions. Such contests are carried out with an enormous amount of snorting, hissing, and enraged breathing

that make them most exciting to the onlookers. The object of this whole performance is the maintenance around the bull of a certain area of clear beach in which the cows will eventually assemble. Deaths are apparently not common in these early struggles, though the strain of the situation is often to be noted in the scarred and bloody condition of many of the combatants. The term "beachmaster" is an appropriate designation for those of the bulls that maintain their places against all comers.

As the bulls are establishing themselves, the cows begin to arrive (Fig. 6). They are relatively small, timid creatures, weighing on the average about seventy pounds. They begin to appear near the tenth of June and continue coming till well into July or even August. Those that arrive early make their way in among the bulls without exciting great attention. They wander about somewhat aimlessly but eventually associate themselves with a given bull, after which they are treated by him as part of his growing harem and more or less jealously guarded. Thus each harem as the season progresses gradually increases in the number of its cows.

The maximum size of a harem can not be stated with accuracy, for as the season advances the cows are in and out of the water continually (Fig. 7). In 1914 the number of cows associated with one bull varied by actual count from 1 to 106. The average harem in that year, obtained by dividing the total number of breeding cows by the number of harem bulls, was approximately 60. It is probable that this number is somewhat too high for the best condition of the herd. There is,

FIG. 8. DISORGANIZING HAREMS TOWARD THE CLOSE OF THE SEASON. Gorbatch Rookery, August 6, 1914.

FIG. 9. ONE OF THE LAST BULLS TO LEAVE GORBATCH ROOKERY; the beach shows a preponderance of pups. Gorbatch Rookery, August 6, 1914.

however, no reason to believe that an average harem of 40 is in any sense an excessive number. What the average harem was in the original condition of the species and before man's intervention, can not be stated with certainty. It is believed to have been not over 40 and it may not have been less than 30.

The cows that arrive from the open sea are gravid females. Within a day or so after they have come ashore and joined a harem, they give birth to a single pup, and probably within a week after the birth of their young they are in heat and impregnated by the bull. The usual period during which the young are carried must, therefore, be a year less about a week. There is apparently no ground whatever for the

FIG. 10. TOWARD THE CLOSE OF THE SEASON; only cows and pups on the beach. Tolstoi Rookery, end of August, 1914.

supposition that the fur-seal breeds biennially and that its period of gestation is approximately two years.

After the cow has been impregnated, the bull is less solicitous about her and she leaves the harem from time to time for the open sea and feeding. During her absence, which at times may possibly cover a period of a couple of days, her pup fasts, but on her return he gorges himself with her milk.

As the season progresses and the pups are born and the cows impregnated, the vigilance of the bulls declines and in the latter part of July and especially in August (Fig. 8) the harems begin to disintegrate and the rookeries become one vast confusion of bulls, cows, and pups (Figs. 9, 10, 11). The bulls, as a result of their incessant activities, are in a state of extreme emaciation. Many of them have been on the beaches from May and during the period between the time of their arrival and the end of July or early part of August, they touch no food. This fast of well over two months coupled with their incessant activity drains them of all their stored energy. Their fat disappears and they are reduced almost to skin and bones (Fig. 12). In this state they may be driven off a rookery without resistance and they soon return to the sea to begin the winter migration. During this period they feed and fatten in preparation for the coming season. Thus early in August or even in July the bulls, who were the first to announce in the spring the coming of the herd, are also the first to take departure and begin the winter movement. They are followed gradually by the rest of the colony (Figs. 13, 14) and by November the rookeries are almost deserted, a few seals occasionally lingering on till well into winter.

From time to time during sealing operations many seal pups have been branded in such fasion as to allow them to be followed year by year as they grew up (Fig. 15). In this way a rough idea of the age of the fur-seal has been arrived at. It seems highly probable that the bulls and cows have approximately the same length of life, namely, from twelve to fourteen years. The bulls begin breeding at about the sixth or seventh year, though some may begin a year or so earlier, and are thus active for about half their lives as breeding individuals in the herd. As young animals they are known as bachelors up to about their fourth year after which they are commonly spoken of as half-bulls till about their seventh year, when they assume the condition of the mature bull. The cows first pair with the bulls at two years of age and bring their first pup to the islands at the close of their third year. If, as is supposed, they live to be twelve to fourteen years old and produce one pup a year, they must add to the herd in the course of a lifetime ten to a dozen new individuals.

About the habits of the cows little more need be said than has already been given in the general account of the formation and disin-

FIG. 11. TOWARD THE CLOSE OF THE SEASON; bachelors mingling with cows and pups. Tolstoi Rookery, August 23, 1914.

tegration of the harems. As already remarked, the cow is a relatively small animal, weighing not more than a fifth or sixth as much as a bull (Figs. 16, 17). They are on the whole timid and can be driven off the beach at almost any time. In the fighting of the bulls they often intervene in a strange way by clinging to the throat of the bull at the onset, after which very little real disturbance is likely to occur. If, however, the contest is really on and a cow comes in the way of the bull, she is likely to be seized by him and thrown bodily some distance back into the harem as a kindly reminder that the field of battle is not the place for females.

After the birth of her pup and her reimpregnation, the cow is free to make excursions from the harem into the open sea for feeding and she may travel in quest of food to a distance of fifty or a hundred miles from the island. On her return she searches long among the pups and eventually accepts one to whom she then gives milk (Fig. 18). With thousands of pups on the beach, it seems incredible that a cow after an absence of a day or more should find her own offspring, but, judging from her actions, she seems to be able to accomplish this feat. With the growth of the pup, she becomes less and less attached to the harem and, as these disintegrate in the latter part of July and early in August, she becomes a general inhabitant of the beach. Here she remains till November, when she takes to the sea for the winter migration.

The pups, one for each cow, are born shortly after the arrival of the cows, that is, between the middle of June and the latter part of July, though newborn pups have been seen occasionally as late as August. At birth they weigh about eleven pounds. They come into the world commonly attached to the placenta, from which they are sooner or later freed by the breaking of the umbilical cord (Fig. 19). The vast number of placentas thus left upon the beach, together with the seal excrement, chiefly from the pups, gradually decompose in the cold northern air and give to the rookeries a penetrating odor, not to say stench, that can be recognized a mile or more away when the wind is in the right direction. This odor can be described as a strong stable smell with a slight aromatic turn to it. It is probably common to most seals and was certainly familiar to the ancients, for we are told in the fourth book of the Odyssey that when Odysseus and his men hid among the seals to surprise Proteus, each held beneath his nostrils some ambrosia with which to overcome the stench from the surrounding animals.

At the height of the season the rookeries are not only permeated by characteristic odors but are the scenes of the utmost confusion. The bulls hissing, snorting, and bellowing, the cows calling in a sheep-like bleat to their pups, and the pups responding in a higher pitch all contribute to a bedlam of noise which deafens the onlooker and has to be experienced to be appreciated. Into this malodorous tumult and con-

fusion the fur-seal pup is born, and yet from the beginning he seems to be quite at home and he certainly thrives under conditions of filth where most animals would be expected to perish outright. His habits are extremely playful (Fig. 20). He is continually rolling about and tugging and pulling at his companions. If a person stoops down in a group or pod of pups, coat tails and trouser legs are likely to be seized and tussled by these little creatures in a way that is wholly pup-like, and the appropriateness of the name becomes at once evident. Till the first week in August the pup remains strictly on shore, after which he begins to take to the water, first paddling and then swimming. Thus he starts his preparation for the winter migration when in November as a plump little seal with a weight varying from twenty-five to fifty pounds he deserts his birthplace on his first migration southward.

FIG. 12. SPENT BULL AT THE CLOSE OF THE BREEDING SEASON. Gorbatch Rookery.

The bulls, cows and pups occupy the real breeding areas of the rookeries, but besides these spaces there is also in every rookery of considerable size an extended area occupied by the young males or bachelors. These areas are known as the bachelors' hauling grounds and are usually to one side of the breeding grounds proper and have free and independent connections with the sea (Fig. 21). Here during the breeding season the young and immature males or bachelors congregate and live a life more or less independent of the rest of the herd. The bachelors begin to arrive on the islands with the bulls, the older ones coming first and the younger later, and they remain till the end of the season, being usually the last ones to depart in December or even later in the winter. They are quite what their name implies, being an unattached, rollick-

ing and disturbing element in the herd. They are incessantly in and out of the water and are known to migrate between the islands during the breeding season (Figs. 22, 23).

With the bachelors are the half-bulls, six or seven years old, and as the harems disintegrate toward the end of the breeding season, these young bulls make their way in among the breeding members of the herd and often establish temporarily a small harem of two or three or more cows which have escaped from other harems or have arrived very late for breeding activities. In this way recruits from the bachelors' hauling grounds are introduced into the herd proper and thus year by year the worn-out bulls are replaced by new and younger stock.

Some uncertainty has prevailed as to the return of yearling seals to the islands, but it now seems to be quite clear that this really occurs. This very young stock, however, does not come to shore until after the actual breeding season is over. It is possible that a few may reach the beaches in the latter part of July, but the majority certainly do not come till after the middle of August. When they arrive, they do not haul out with the bachelors, but come to shore where the harems have disintegrated and associate themselves chiefly with the pups, from which they do not differ greatly in size. The pups on leaving the islands in November have an average weight between 37 and 38 pounds. When they return in the following August as yearlings, their weights range according to actual records between 33 and 41 pounds. Apparently during their nine months at sea they have not gained much in weight, if in fact they have not lost, but they have exchanged fat for muscle and thus have laid the foundations for that career of vigor and exertion to which all successful fur-seals must look forward.

The main facts in the life of the fur-seals, both male and female, are thus fairly well established. Many details are still to be added, but in general the life history of this species is well worked out. Born as a pup in one year the male yearling returns late in the season of the next year to play on the breeding grounds with the pups of that year. As a two-year-old on his second return to the islands he enters the ranks of the bachelors, where he remains till his sixth or seventh year, when as a half-bull he begins to take part in the breeding of the herd. He now transfers all his activities to the breeding grounds and as a full-grown bull or beachmaster works at the establishment of a harem season after season till his end comes at approximately his twelfth or fourteenth year.

The activities of the cows run a somewhat different course. The cow pup after her first migration probably returns to the islands as a yearling late in the second season to play among the pups as the yearling males do. On her second return as a two-year-old she arrives on the breeding grounds a little in advance of the disintegration of the

FIG. 13. COWS AND PUPS SWIMMING. Vostochni Rookery, August 17, 1914.

harems. She enters one of the harems formed late in the season by the younger bulls and becomes impregnated for the first time. In consequence of this her first pup is brought to the island at the end of her third year when she enters regularly into the breeding activities of the herd and adds a pup to the seal population for each subsequent year in her life. Thus the fur-seal herd maintains itself through the intensive and regular but relatively brief breeding season on the islands alternating with the annual winter migration of some six to nine months during which its members spend their whole time in the open ocean, for, though their migration route extends as far south in the Pacific as Southern California, they are never found close to shore.

The only way the early Russian sealers had of procuring the skins of the fur-seal was by capturing these animals in the open sea during their migrations. After their breeding haunts were discovered, land killing became the customary method and for this purpose in 1799 the Pribilof Islands passed into the control of the Russian-American Company. This company killed for their pelts large numbers of young seals, both male and female, till 1835, when the herd was so far reduced that restrictive measures were deemed necessary. Between 1786 and 1834 it is estimated that nearly two millions of seals were taken on the Pribilofs. From 1835 to 1867 the killing was more restricted and female seals were spared, a practice which has ever since been adhered to. As a result of these regulations the herd increased and, though over 600,000 skins were taken between 1835 and 1867, the herd when it passed into the hands of our government was variously estimated as containing from two to six millions of animals.

Under the management of the United States the privilege to kill seals on the Pribilofs was leased in 1870 to the Alaska Commercial Company for twenty years. On the expiration of the lease, a second one for another twenty years was made to the North American Commercial Company. This new lease expired in 1910, after which the government abandoned the leasing system and undertook the management of the herd itself. From the time when the Pribilofs passed into the possession of the United States till the end of the second American lease in 1910, over 2,500,000 skins were taken on the islands, and during this period, especially the latter half of it, the herd showed a steady decline in numbers. The cause of this decline was much discussed, but it is now generally agreed that it was not due to the regular killing on land, but to the practise of pelagic sealing which as an occupation had steadily grown.

In the early years of the sealing industry a certain number of seals were killed at sea during their migration or while on their feeding excursions from the islands. The sealers who obtained skins in this way were known as pelagic sealers. They were not very numerous till 1879,

after which they increased very considerably in numbers till the practise was put down. At first the pelagic sealers were chiefly Canadians and Americans, but in later years many Japanese were engaged in this business. The pelagic sealers not only often captured more seals than were killed on the islands, but they killed in addition many seals that could not be retrieved and whose bodies were lost in the sea beyond recovery. Moreover from sixty to eighty per cent. of their catch were females whose pups must subsequently have died of starvation and whose importance for the further maintenance of the herd there and then ceased. It is, therefore, not surprising that with the development of pelagic sealing the herd should show a steady decline.

FIG. 14. YOUNG SEALS ON TOLSTOI BEACH, August 25, 1914.

Recognizing this fact, the United States took steps to protect its seal herd, with the result that it became involved in a controversy with Great Britain, some of whose citizens were active in pelagic sealing. It was finally decided by the two powers concerned to submit the whole matter to a tribunal of arbitration to meet in Paris in 1893. Meanwhile Great Britain agreed to prohibit British subjects from sealing in the eastern part of Bering Sea and the United States prohibited all killing of fur-seals whatever by its citizens except that 7,500 should be killed annually as food for the Pribilof natives. This agreement, commonly known as the "Modus vivendi," originally applied only to the year 1891, but it was renewed for 1892 and 1893.

As a result of the deliberations of the Paris tribunal, pelagic sealing was prohibited in a zone of sixty miles radius around the Pribilofs

and was prohibited entirely between May 1 and July 1. These regulations, which were subject to reexamination at intervals of five years, went into effect in the summer of 1894. Nevertheless the catch from pelagic sealing continued to increase and the seal herd correspondingly continued to decrease. In 1896 the United States accepted the proposal of Great Britain to institute independent investigations of the entire question at the close of the five-year trial period. These investigations were made in 1896 and 1897 and the voluminous report of the American investigators was published in 1898. Meanwhile Congress toward the close of 1897 had enacted a law forbidding citizens of the United States from engaging in pelagic sealing at any time or place.

A new lease to the North American Commercial Company was not granted when in 1910 the old one expired, but the United States government assumed the full management of the herd. Toward the close of the following year a treaty was made effective between the United States, Great Britain, Russia and Japan, whereby sealing on the high seas was abolished for a period of fifteen years. By its provisions the United States and Russia, as owners or guardians of the seal herds, agreed to pay both to Great Britain and to Japan, for the relinquishment of their interest in pelagic sealing, fifteen per cent. each of the income from the United States and the Russian herds. In like manner Japan agreed to pay to the United States, to Great Britain and to Russia ten per cent. each of the value of the catch from her small but growing herd. Finally in 1912 in consequence of the reduced state of the Pribilof herd, the Congress of the United States passed the present law to the effect that no fur-seals should be killed on the Pribilofs for a period of five years except such as were needed as food for the natives, and that a breeding reserve of not less than five thousand three-year-old males be made annually during the life of the treaty suspending pelagic sealing. For some time past it had been the rule to make some form of count of the Pribilof fur-seals as an indication of the state of the herd. Since 1896 counts of the actual number of harems had been made annually. These counts had been carried out at what is called the height of the season, usually between the tenth and twentieth of July. Since 1912 the total number of pups born in the season has been counted and on the basis of the count of pups and of harems a fairly accurate estimate of the total strength of the herd has been made.

Proteus is said to have counted the seals of his Mediterranean haunts in fives and then to have lain down among them like a shepherd amid his flock. But when one looks over a modern fur-seal rookery with its myriads of active animals, some in the sea and others out and all in commotion and confusion, an estimate of the assemblage, not to

FIG. 15. BRANDED COW PROBABLY TWELVE YEARS OLD. Kitovi Rookery, August 23, 1914.

say a close enumeration, seems impossible. And yet with a little care and good management an enumeration of at least certain elements in the herd can be carried through with considerable accuracy.

At the height of the season, that is, about the middle of July, it is possible to walk along the upper edge of the beaches on which the rookeries are situated and count with fair certainty the bulls with their surrounding harems. At this stage of the breeding activities all the bulls have long since arrived and none have begun to depart,

FIG. 16. COW AND PUP. Kitovi Rookery, August 25, 1914.

hence the conditions are favorable for a census. The bulls themselves, because of their size, are conspicuous creatures and even on very rocky beaches it is almost impossible to overlook them. In a few places, such as on Reef Rookery and especially on Vostochni Rookery under Hutchinson Hill, the harems instead of being strung along the beach are massed in considerable numbers and here the counting of the bulls was not easy, but on almost all other parts of the rookeries the counting of the bulls could be carried out with as much ease and accuracy as the counting of lamp posts or telegraph poles along a street. In this way a close count, accurate within very few per cent., can be made of the breeding bulls.

Toward the end of July the bulls begin to lose their ferocity and some of them even desert the rookeries for the open sea. At this time the majority of them can be driven at least temporarily into the water and with them all the cows. As a result the only members of the herd left on the beach are the pups. These do not naturally take to the water till after the first week in August and therefore at this season they may be counted, after temporarily clearing the beach of the rest of the herd (Fig. 24). In counting these active little creatures operations are begun at one end of a rookery. The pups are assembled in small groups or pods, and pod by pod is driven off in a thin line first on to the unoccupied beach and then, as the count proceeds over the rookery, on to that part freed of pups by the earlier count. The pups string out and run at a mild pace and may be counted as a miniature flock of sheep would be counted. After the live pups have been counted the beach is examined for dead ones and the number thus found is added to the number of living pups to give the total pup count.

This enumeration is also an accurate one, though not so accurate as that of the bulls. Pups may hide among the rocks and thus be omitted, but, aside from omissions of this kind, the count can be made a close one.

The cows, as already indicated, are coming and going between the rookeries and the sea almost continuously and therefore can not be counted with accuracy. The fact, however, that cows are known to produce only one pup each in a season allows a minimum estimate of the breeding cows to be made, for there must have been on the beaches in a given season at least as many cows as there were pups born. In this way the least number of breeding cows for a given year can be accurately inferred.

Rough counts can be made of the idle bulls, that is, of those bulls that have failed to establish harems and that spend their time on the outskirts of the breeding areas attempting to gather a few of the late

FIG. 17. SLEEPING COW AND PUP. Kitovi Rookery, August 23, 1914.

cows about them. These animals move about more or less and can not therefore be enumerated closely.

Finally the bachelors with their roving dispositions can not be dealt with except in the form of roughest estimates, upon which only slight weight can be placed. The fact that they are known to migrate from one island to the other in the course of the season shows that many may be at sea at a given time and that therefore any count of those on land can not be relied upon to represent their total number. This element of the herd is the only considerable one that can not be dealt with in any accurate way so far as enumeration is concerned.

In following the condition of the herd, the count of the new-born pups is of first importance, though the number of harems formed is also of great significance. The pups were first actually counted in the season of 1912, when somewhat fewer than 82,000 were noted. In 1913 over 92,000 were recorded. These two enumerations, which entailed an almost incredible amount of work, were made by Mr. George A. Clark, whose long services in connection with the Pribilof seal herds are well known. The enumeration of 1914 was made by an international party of investigators consisting of Mr. James M. Macoun and Mr. B. W. Harmon, representing Great Britain; Dr. T. Kitahara, representing Japan, and Mr. Wilfred H. Osgood, Mr. Edward A. Preble, and the author, representing the United States. The number of pup seals found by this party for 1914 was a little over 93,000, a slight increase only over the number of the preceding year. In the summers of 1915 and of 1916 the enumerations were made by one of the island officials, Mr. G. Dallas Hanna, with the result that increasing totals of new-born pups, namely, over 103,000 for 1915 and about 117,000 for 1916, have been reported. Not only has the total births of pups increased year by year, but the number of breeding

FIG. 18. COW NURSING PUP. Tolstoi Rookery, August 25, 1914.

bulls with their harems has also begun to move forward. In 1912 this number was 1,358, in 1913 it was 1,403, in 1914 1,559, in 1915 2,251, and in 1916 3,500. The average harem, which represents the average number of cows that must be served by a bull, has shown during this period a favorable decrease. In 1912 it was 60.4; in 1913 65.8; in 1914 59.3; in 1915 45.5, and in 1916 36.3. Thus in all respects the fur-seal herd under the new conditions shows all the signs of rapid recuperation. Its total size, for reasons already stated, can not be given with accuracy, but it is not unlikely that at present it contains not far from a third of a million of individuals. This number is far short of the two to six millions that it was supposed to contain when it was transferred from Russia to the United States. But whether these early estimates were correct or not can not be known and all that can be said at present is that, so far as well-established numbers are concerned, the tide has changed and in place of an unfavorable decrease a period of profitable increase and sound growth is well established.

FIG. 19. NEWBORN PUP WITH PLACENTA STILL ATTACHED. Tolstoi Rookery, June 25, 1914.

The present law concerning the management of the Pribilof fur-seals prohibits the killing of what under ordinary circumstances would be the killable male stock, except in so far as it is needed as food for the natives. As a result of this law only a few thousand seals are killed annually and this small number will remain the number killed till the resumption of activities on a commercial scale after the season of 1917. Moreover the law prescribes that on the resumption of these activities an annual reserve of not fewer than five thousand three-year-old males for breeding purposes be made until 1926 inclusive.

FIG. 20. PUPS. Gorbatch Rookery, August 19, 1914.

The scheme of management thus outlined is neither for the advantage of the fur-seals nor for that of the government. The fur-seals, like other mammals, produce about equal numbers of males and females. Close counts show that there are one or two per cent. more males than

FIG. 21. BACHELORS "HAULED OUT" ON TOLSTOI BEACH, late in August, 1914.

females, but the difference is so slight that equality may be assumed. When, however, the animals arrive at the breeding age one male, as has already been shown, may have over a hundred females in his harem and though this number must be unduly large, it is generally believed that an average harem of thirty to forty cows is in no sense excessive. If the sexes are produced in approximately equal numbers and yet on the breeding ground under the best of circumstances one male serves thirty to forty females, it must follow that many males play no part in the breeding activities of the herd. These in fact are the so-called idle bulls and their number is in a way a measure of this maladjustment. They are sources of disturbance to the breeding individuals and they represent material that should have been killed when their pelts were in their most marketable state, that is, three years old. The most obvious course therefore to be pursued so far as the male of the herd is concerned is to retain at the most marketable age a certain proportion, not a fixed number as the present law prescribes, for breeding purposes and kill all others. If the breeding life of males and females was of the same length and these animals were associated in the proportion of one male to forty females, the reservation of one male in forty at the three-year-old stage would just supply the requisite number of breeding bulls. But the bulls breed only over some six or seven years, whereas the cows are sexually active for almost twice that period. Hence the male reserve should be at least two in forty, or five per cent. The recent suggestion, therefore, that the male reserve should be eight per cent. of the three-year-old bachelors is well on the side of conservatism. Such a solution of the question is very much more in line with

the actual needs of the case than the prescription of a definite number of reserved males as is done by the present law. The system suggested has the advantage of applying successfully to a herd of any size be it one of thousands of individuals or millions.

The practical application of such a reserving system is relatively simple. The reserve first of all should be made in seals of one age, the most marketable so far as their skins are concerned, namely, the three-year-olds. In the drives it has been demonstrated that the native killers can pick out individuals of this age with almost perfect certainty. All that it is necessary to do in making this reserve is to mark eight per cent. of the three-year-old seals in a given drive by cropping the hair on one side of their heads with ordinary sheep shears and then ignoring such marked individuals in all future drives. Such seals are easily recognizable throughout the rest of the season and on their return the next year they have automatically passed on to the four-year class and are thus preserved as breeders.

The only objection to this system that has been raised is that it assumes that a better proportion of the sexes for breeding purposes can be worked out by man than has been established by nature. That such an improvement has already been successfully practised by man is well demonstrated in the common barnyard fowl. This bird both in its wild state and in its domestic condition produces about equal numbers of males and females, yet in its breeding habits one cock serves successfully a number of hens. It is as preposterous to claim that the

FIG. 22. ROVING BACHELORS. Kitovi Rookery, August 23, 1914.

FIG. 23. STAMPEDE OF BACHELORS AT TOLSTOI BEACH, August, 1914.

natal proportions of the sexes of the fur-seals can not be readjusted advantageously by man as it would be to maintain that there must be one cock for each hen in the barnyard for the reason that nature has produced the two sexes in equal numbers. The elimination of a reasonable proportion of the male fur-seals from the herd can have no other effect than to reduce somewhat the daily conflicts between the members of this sex and is certainly a step in the direction of increased welfare for the herd as a whole.

From the standpoint of the government such a proportional killing of three-year-old seals is also advantageous, for it would increase considerably the present supply of marketable seal skins and not only not endanger the herd but, as already indicated, put it in a more favorable condition. The increase of revenue thus brought about is estimated in the hundreds of thousands of dollars annually, sums which under the

FIG. 24. COUNTING PUPS ON GORBATCH ROOKERY, July 30, 1914.

present law are slipping through the fingers of the government. Since the fur-seal herd of the Pribilofs contains at present probably not far from a third of a million of animals and is therefore nowhere near extinction, and since the breeding habits of these seals are such as to call forth a steady increase of useless males, it seems only reasonable that a law that gives these males undue protection should be revised, whereby a safe proportional killing of them should be permitted. In this way the herd could be rendered more stable and the government would receive a greatly increased income which at present is being dissipated in the open Pacific. In other words, the Pribilof fur-seal herd is not only in active process of restoration but a reasonable form of commercial killing should have been resumed several years ago.

SHISHALDIN AND ISANOTSKI VOLCANOES, NEAR UNIMAK PASS.

THE SCIENTIFIC AND ADMINISTRATIVE ACHIEVEMENT OF THE MEDICAL CORPS OF THE UNITED STATES ARMY

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WHEN the history of the present European war comes to be written, it will be found that the part played in the great world struggle by the medical officers of the different armies engaged has been in every way as important as the achievements of the line. Not only has the mortality of the army surgeons in the different battles been fully as high as that of the infantry, but the military administrators have been compelled to admit, reluctantly in some cases, that the medical profession has been their mainstay in the matter of evacuating the wounded from the battlefields and in sending a majority of the wounded back to field service in an incredibly short space of time. In the past, the status of the army surgeon was as dubious as that of the rest of his professional brethren. In seventeenth and eighteenth century Prussia, he was still a barber surgeon who shaved the officers of the line, and only a few years ago, a British medical officer who had been rewarded for heroism in the field was contemptuously dubbed "a brave civilian" by the commander of the British army, a man who never saw a battle. Modern wars have changed all that. The commanding officer of to-day, who is wise, instinctively acts according to the sentiment of General Winfield Scott: "I am in the habit, myself, when on duty with troops, of paying great deference, and even of yielding my opinion, on matters deeply affecting health and life, to the advice of my medical staff." "War," said the Russian army surgeon Pirogoff, "is a traumatic epidemic. Not medicine, but administration plays the leading part in the aid of the sick and wounded in the scenes of war." The work of Pasteur and Lister has made the first part of this aphorism negligible. Thanks to antiseptic surgery, we no longer fear the traumatic infectious diseases in the field or base hospitals. But the second part of Pirogoff's dictum reveals the wonderful prescience of the gifted Russian. Medicine is now slowly coming into its own. The army medical officer of to-day must not only be a trained scientist but a capable administrator. In other words, his duties in the zone of advance, the line of communications, and the interior, are in every respect as onerous and exacting as those of the line or engineer officer, and the story of his accomplishment, in the present war, will, when told, make a brilliant record. At the present moment, it seems fitting and proper

to draw public attention to the scientific and administrative achievement of the Medical Corps of our Army in the past. In preparing this record, I have been much indebted to Dr. Fielding H. Garrison (Surgeon General's Library), who has summarized the recent work of the Medical Department of the Army in his "History of Medicine" (1913, 1917).[1]

During the colonial period, the status of medicine on this continent was of the most provincial character, its practitioners being sometimes ministers of the Gospel, oftener men who had got their training with physicians under indentures of apprenticeship, with no medical degree whatever, self-trained mid-wives for obstetric cases, back-woods sawbones who had acquired their knowledge of surgery in the most rough and ready fashion, and a few settlers who had acquired a legitimate education in Europe, with the still more favored few whose parents were able to give their sons a proper medical education at some European university. The title "doctor" was not even employed in the Colonies before 1769. Medical legislation in the several states was mainly centered upon the regulation of physicians' fees, and with the exception of the Acts of Massachusetts in 1649 and 1699, and of New York in 1665, little of it was restrictive, in the sense of excluding the incompetent, or of application to the prevention of infectious diseases.[2]

With the Revolutionary War, which has been described as "the making of medicine in this country," things took a new turn. Morgan, Shippen and Rush, the three Surgeons General who did most for the medical service of the Army in this War, were also the three greatest American physicians of the period. John Morgan (1735–89), who was appointed Director General and Physician in Chief of the American Army in 1775, and William Shippen (1736–1808), who succeeded him in 1777, were the leading pioneers in advancing medical education in this country, having collaborated as founders of the Medical Department of the University of Pennsylvania in 1765. Benjamin Rush (1736–1808), who was appointed Surgeon General of the Hospital in the Middle Department in 1777, transferring to the position of Physician General twelve weeks later, was regarded, both in Europe and America, as the greatest American physician of the period, being somewhat effusively styled the American Sydenham and the Hippocrates of Pennsylvania. Although he deserted Washington at Valley Forge to join the "Conway Cabal," Rush was the author of a valuable pamphlet on the hygiene of troops (1777), the first American treatise on insanity (1812), and the first contributions made in this country to the then unknown science of anthropology (1774–88). He was perhaps the first physician to describe cholera infantum (1773), the second to describe dengue (1780), and the part he played in fighting the epidemic

[1] Garrison, "Introduction to the History of Medicine," Philadelphia, 1913, 618–620; 2d ed., 1917, 732–736.

[2] *Ibid.*, 2d ed., 1917, 296–298.

of yellow fever in Philadelphia in 1793 is a prominent feature of the history of that city.

The earliest American pharmacopœia to be printed was that prepared for the use of the Continental Army by Dr. William Brown, of Virginia, who succeeded Rush as Physician-General of the Middle Department (1778–80). It was issued from the military hospital at Lititz, Lancaster County, Pa., and appeared anonymously as a Latin booklet of thirty-two pages in 1778. A facsimile of the title-page of the second edition (1781), which bears the name of Brown, may be seen in Dr. Handerson's translation of Baas's "History of Medicine" (p. 820). A unique copy of the rare first edition is on exhibition in the Surgeon General's Library.

James Thacher (1754–1844), who became Assistant Surgeon in 1775, left a remarkable "Military Journal during the American Revolutionary War" (1826), which is an authoritative source of historical information, describing the treason of Arnold, and the capture of André, and giving perhaps the best contemporary appreciation of the character of Washington. Thacher was also the author of the first American work on medical biography (1828), which makes him, in a sense, our first medical historian.[3]

John Jones (1729–91), who had been a surgeon of French troops in the war of 1758 and afterwards rendered worthy service in the Revolution, published a treatise on wounds and fractures in 1775, which was the first surgical work published in this country, and, through its appendix on camp and military hospitals, the first American book on military medicine.

Of the early Surgeons General after the Revolution, James Tilton (1745–1822) introduced the "hut system" during the war, to avoid overcrowding of hospitals, and also published the first American book on medico-military administration (1812). Joseph Lovell (1788–1836), appointed Surgeon General upon the formal organization of the Army Medical Department in 1818, organized the Department and revised its regulations, giving it the form which it retained up to 1861. In 1834, he introduced competitive examinations for admission to the Corps and he abolished the whiskey ration. Thomas Lawson (1795–1861), Surgeon General from 1836 until the outbreak of the Civil War, secured actual military rank without command for the Army Medical Officers in 1847, and, in 1856, enlarged the capacity of his commissioned force by the enlistment of hospital stewards as such.

William Alexander Hammond (1828–1900), Surgeon General during 1862–64, early made his mark as a physiologist by his essay on "The Nutritive Value and Physiological Effects of Albumin, Starch

[3] The first American book on the history of medicine was actually a work of the colonial period, viz., Peter Middleton's "A Medical Discourse, or an Historical Inquiry into the Ancient and Present State of Medicine," New York, 1769.

and Gum when singly and exclusively used as Foods" (1857), which was awarded the prize of the American Medical Association in 1857, gave him a European reputation and secured him the Chair of Anatomy and Physiology in the University of Maryland in 1860. During his war service as Surgeon General, he introduced many reforms and improvements in the medical service, such as the issue of a new and enlarged supply table, the furnishing of suitable hospital clothing to patients, the establishment of a new and complete system of hospital reports, the reorganization of examinations and examining boards for the medical service, and the extensive construction of hospitals built upon the pavilion system. Of Hammond's career as Surgeon General Dr. Weir Mitchell said:

> Whatever else may be thought or said of William A. Hammond, nothing is more sure to me than that he duly saw and grasped a great opportunity; that he served his country as few could have done; that he created the Army Medical Museum; that he saw the need for and advised the creation of the Army Medical School; that he pointed out the men who were to direct the Army Museum and the Army Library. Until the end of his Army career he was the unfailing friend of scientific study, and created special hospitals for diseases of the heart, lungs and neural maladies.

At these hospitals, Acting Assistant Surgeon J. M. Da Costa first described irritable heart in soldiers (1862), and Acting Assistant Surgeons S. Weir Mitchell, George R. Morehouse and William W. Keen made their investigations of gun shot and other injuries of nerves (1864), which have since become classical. Hammond's systematization of medico-military reports led to the "Medical and Surgical History of the War of the Rebellion" (1870–88), which was completed under his administrative successors, Joseph K. Barnes (1864–82), Charles H. Crane (1882–3), Robert Murray (1883–6) and John Moore (1886–90), by Surgeons George A. Otis, Joseph Janvier Woodward, Charles Smart and David L. Huntington. This is a great collection of surgical and medical case histories and pathological reports, in six huge quarto volumes, embellished with splendid plates, a work which soon became known all over the civilized world as the most remarkable contribution to military medicine made up to that time. It received the highest praise from Professor Rudolph Virchow, the greatest of modern pathologists. After his dismissal from the Army, in consequence of his difficulties with Secretary Stanton, Hammond went to New York, where he became a noted authority on nervous diseases and insanity, through his treatises on these subjects, published in 1871 and 1883 respectively. He was the first to describe the neurotic condition known as "athetosis" (1873), and was editor of the *Quarterly Journal of Physiological Medicine and Medical Jurisprudence* (1867–72), the *New York Medical Journal* (1867–9), and the founder and editor of the *Journal of Nervous and Mental Disease* (1867–83).

To Hammond's successor, Joseph K. Barnes (1817–83), Surgeon General during 1864–82, fell the task of disbanding the huge corps of civil physicians serving the army under contract, dismantling and discontinuing the great hospitals, settling outstanding accounts and noncontinuing appropriations, which was carried forward under the direction of his able assistant, Surgeon J. S. Billings. Under Barnes, the exclusive control of general hospitals and hospital camps was vested in the Medical Department, the publication of the Medical and Surgical History of the War was begun, the development of the Army Medical Museum and Library was fostered under the direction of Billings, and the exhaustive Reports upon Barracks and Quarters and Hygiene of the Army, edited by Billings, were published in 1870 and 1875 respectively. Next to the Medical and Surgical History of the War, these were the most important contributions made to military medicine in this period.

Under John Moore (1826–1907), Surgeon General during 1886–90, instruction in first aid was inaugurated in the service in 1886. This was one of the most important steps for the welfare of trooops, in connection with which the first aid books of Dietz, Smart and Pilcher were published and the Hospital Corps of the United States Army was organized by Act of Congress in 1887, resulting in the drill manuals of Pilcher, Heizmann, Hoff, Havard, Woodhull and Dietz. The last volume of the Medical and Surgical History of the War was published in 1888.

Charles Sutherland (1831–95), Surgeon General during 1890–93, gave the Medical Department a new field equipment, gave the post hospitals sole authority for the issuance of surgical supplies and furthered the development of the Hospital Corps.

George Miller Sternberg (1838–1915), Surgeon General 1893–1902, was the first to isolate the bacillus of croupous pneumonia (1880), published the first manual (1893) and text-book (1896) of bacteriology, and important treatises on immunity (1895), disinfection (1900) and infection (1903). He did important scientific work on yellow fever, and, under his administration, the agent of transmission of yellow fever was discovered by Major Walter Reed in 1901, and the sanitary regeneration of Havana was accomplished by Major William C. Gorgas, shortly after. During the Spanish-American War, General Sternberg met all the increased demands upon his corps with efficiency, in the face of legislative embarrassment and administrative obstacles, establishing a corps of female nurses for service in permanent hospitals, increasing the medical staff by officers selected from the Association of Military Surgeons, and afterwards supervising the organization of medical service in our new tropical possessions. He founded the Army Medical School, established laboratories of bacteriology and hygiene in connection with the Army Medical Museum, secured the assignment of medical

officers to stations in large cities affording unusual advantages for advanced medical studies, established a sanatorium at Fort Bayard for the treatment of pulmonary tuberculosis, created a special surgical hospital at Washington Barracks, and organized additional schools for the Hospital Corps.

Robert Maitland O'Reilly (1845–1912), Surgeon General during 1902–9, was an active member of boards for selecting camp sites during the Spanish-American War and the cleaning up of Havana after it. Upon assuming the office of Surgeon General, he immediately set himself to the task of carrying out the recommendations made by the Dodge Commission for the improvement of the Army Medical Corps, as the result of which it is now able to equip its hospitals and field units more rapidly than they can be organized and their personnel brought together. He created the Medical Reserve Corps of the Army for the expansion of its medical service in time of war, in which many distinguished physicians and surgeons of the country are now enrolled. He organized and presided over the Board recommending the adoption of preventive vaccination against typhoid fever in the army, and it was due to his good offices that Professor Russell H. Chittenden, of Yale University, was able to use a squad of Hospital Corps men in carrying out his important experiments upon the physiological economy of nutrition, the practical object in view being to ascertain the best scheme of rations for troops under modern conditions.

George H. Torney (1850–1913), Surgeon General during 1909–1913, instituted compulsory vaccination against typhoid fever among United States troops, also the measures for the control of venereal diseases in the Army and of beri beri in the Philippines. All these have been most effective. During the mobilization of United States troops on the Mexican border in 1912, Major Frederick F. Russell vaccinated the entire body, some 20,000 men, against typhoid fever, and by further vaccinations throughout the army has brought down the morbidity and mortality record of this disease to practically zero. Beri beri has practically disappeared among the rice eating native troops in the Philippine Islands, largely through the investigations of Captain Edward B. Vedder. At the outbreak of the Spanish-American War, in May 1898, Torney was ordered to equip and command the United States Army hospital ship *Relief*, and, under his direction, transportation of the sick and wounded from Cuba and Porto Rico to the United States was accomplished in the most efficient way. When the Mexican mobilization took place, the medical equipment of the manœuver division included a complete modern sanitary organization, with full quota of field hospitals and ambulance companies in addition to the regimental sanitary service. General Torney also advocated the bills which reorganized the Dental Corps of the Army and the Army Nurse Corps. At the

time of the San Francisco earthquake and fire, General Torney was commanding officer of the General Hospital at the Presidio, and upon him devolved the general management of medical relief and sanitation in connection with the disaster. Of his splendid work on this trying occasion, the San Francisco *Examiner* says:

> By the provisions of General Orders No. 37, General Funston performed, perhaps, the most important act of his administration of the affairs of the city of San Francisco; for by this order he placed the sanitary affairs of the city under the one officer of the United States Army who is the most competent to care for the greatest problem now confronting its courageous citizens. As commanding officer of the General Hospital at the Presidio, Colonel George H. Torney has already made a name for himself which will always live in the memory of San Francisco. Who will ever forget the work he has done for humanity at that magnificent institution? When every other hospital in the city was threatened with destruction and patients were being carried out as fast as willing hands could care for them, Colonel Torney was receiving them at the General Hospital, as fast as automobiles, carriages, wagons and ambulances could carry them to the Presidio. He was one of the first to realize the magnitude of the calamity and without waiting for orders from any one, he notified the city authorities that the General Hospital was at the disposal of its wounded and dying. It is indeed refreshing to see an officer act so quickly and courageously without the usual amount of red tape.

William Crawford Gorgas (1854–), of Mobile, Alabama, Surgeon General since January 16, 1914, was chief sanitary officer of Havana during 1898–1902, and chief sanitary officer of the Panama Canal from March 1, 1904. His brilliant work in ridding Havana and the isthmus of yellow fever and other dangerous infections will be considered below.

It now remains to describe the scientific work done by individual medical officers of the army, apart from the Surgeon Generalcy.

Before the days of Reed and Gorgas, perhaps the most distinguished name of the Medical Corps in the annals of science is that of William Beaumont (1785–1853), who was the pioneer of experimental physiology in this country and who made the most important contribution to the physiology of digestion for centuries. In June, 1822, Surgeon Beaumont, then stationed at the distant outpost of Fort Mackinac, Michigan, came in contact with a young French Canadian, Alexis Saint Martin, who had sustained a severe accidental gunshot wound of the chest and abdomen. Under Beaumont's treatment the wound was partially healed at the end of about ten months, with the exception of a permanent opening in the stomach or gastric fistula. As Saint Martin was declared a "common pauper" by the civil authorities of the county, Beaumont took care of him in his own house, dressing his wounds daily for nearly two years, and during this time, he became impressed with the fact that the permanent gastric fistula of his patient could be utilized for physiological experimentation. In May, 1825, he began his experiments, a long series of patient researches covering eight years, and although Saint Martin frequently deserted him, and had to be

tracked and brought to the different army posts at Beaumont's own expense, on one occasion nearly two thousand miles, his perseverance was rewarded when he published his "Experiments and Observations on the Gastric Juice, and the Physiology of Digestion" (Plattsburgh, N. Y., 1833), which soon became recognized as one of the great classics of physiology. Beaumont was the first to describe the movements of the stomach, the secretion of its juices and the phenomena of gastric inflammation, as seen by the naked eye, his results anticipating much modern work; and he made studies of the effect of the gastric juice upon different foods which are the foundation of modern dietetic scales. Of his work, Sir William Osler said, in an address made at St. Louis on October 4, 1902:

> You do well, citizens of St. Louis and members of our profession, to cherish the memory of William Beaumont. Alive you honored and rewarded him, and there is no reproach against you of merit neglected and talents unrecognized. The profession of the northern part of the state of Michigan has honored itself in erecting a monument to his memory, near the scene of his disinterested labors in the cause of humanity and science. His name is linked with one of your educational institutions, and joined with that of a distinguished laborer in another field of practise. But he has a far higher honor than any you can give him here—the honor that can only come when the man and the opportunity meet and match. Beaumont is the pioneer physiologist of this country, the first to make an important and enduring contribution to this science. His work remains a model of patient, persevering investigation, experiment and research, and the highest praise we can give him is to say that he lived up to and fulfilled the ideals with which he set out and which he expressed when he said: "Truth, like beauty, when 'unadorned, is adorned the most,' and, in prosecuting these experiments and inquiries, I believe I have been guided by its light."

During Surgeon General Barnes's administration, following the Civil War, his medical staff consisted of a brilliant group of officers who did some remarkable scientific work. Of these, Joseph Janvier Woodward (1833–84) was an expert pathologist, and the best worker of his time in photo-micrography, or the photographic enlargement of pictures of microscopic objects, in which he was a pioneer. In this work he was assisted by Edward Curtis (1838–), who, in 1869, collaborated with Billings in investigating the supposed microscopic organisms causing diseases of cattle. General Alfred A. Woodhull (1837–) was the first in this country to employ the British Indian method of giving large doses of ipecac in dysentery (1875–6), catalogued the specimens in the surgical section of the Army Medical Museum (1866), and has written valuable manuals on litter drill for Hospital Corps men (1899) and military hygiene for officers of the line (1898). He also made an important report on the Medical Department of the British Army in 1891, and is the author of suggestive studies on the causation of yellow fever (1877–80) and the sanitary relations of military sites (1894). George A. Otis (1830–81) collaborated with Woodward, Charles Smart

and David L. Huntington in the Medical and Surgical History of the War, of which his surgical reports on amputations at the hip joint (1867) and excisions of the head of the femur for gunshot injury (1869) won the admiration of army surgeons all over the world. The most remarkable member of the group was John Shaw Billings (1838–1913), who, during the war, was the first surgeon in this country to attempt the rare operation of excision of the ankle joint (January 6, 1862), with complete recovery of his patient. To his enterprise, perseverance and ability was due the building up of the Surgeon General's Library, which is now the second largest, and through its unrivaled collection of periodicals, the best medical library for actual use in the world. The Index Catalogue of this library, begun by Billings in 1880, with the assistance of his faithful coadjutor, Dr. Robert Fletcher, and continued to date, places the entire literature of medicine, including the contents of periodicals, at the physician's ready disposal, and is used by scientific workers and libraries everywhere. In many important respects it is the most important and extensive bibliography in existence, the first and second series now numbering thirty-seven large quarto volumes (1880–1916). The first volume of a third series (1917) is already in process of publication. Billings was also the designer of the Johns Hopkins and other modern hospitals, supervised the vital and medical statistics of the tenth, eleventh and twelfth censuses, was the leading American authority in his day on military medicine, public hygiene and sanitary engineering, and wrote what is regarded as the best history of surgery in the English language. Upon his retirement from active service in the army, he planned and organized the New York Public Library and its many branch establishments. The many other achievements of this tireless worker would fill a volume.

Dr. Robert Fletcher (1823–1912), after an honorable career in the Civil War as army surgeon, became Dr. Billings's associate in the Surgeon General's Library, edited the *Index Medicus* (1879–1911), was author of the treatise on anthropometry in the statistical volumes of the Provost Marshall's Bureau (1875), of a valuable monograph on "Prehistoric Trephining" (1882), and made many original contributions to anthropology and medical folk-lore.

Dr. H. C. Yarrow, who was surgeon of the Fifth Pennsylvania Cavalry during the Civil War, was acting assistant surgeon in the United States Army for thirty years, during which time he served on exploring expeditions and in the Surgeon General's Library, and made worthy contributions to herpetology, ichthyology and anthropology, notably an extensive study of the mortuary customs of the North American Indians (1880–81).

Jonathan Lettermann (1824–72), of Canonsburg, Pa., was Medical Director of the Army of the Potomac (1862–3), and during this period, brought order out of chaos by his wonderful reorganization of the med-

ical service in the field. He devised a new ambulance system for evacuating the wounded from the field, perfected the present system of supplying the army with medicines and medical material, inaugurated the system of field hospitals for the immediate relief of the wounded and their speedy return to the firing line, improved the blank forms for medico-military reports and did much to combat camp diseases. His record has only been equalled in the past by that of the immortal Larrey, of Napoleon's army.[4]

In accordance with the liberal policies of General Sternberg's administration, Major Walter Reed (1851–1902) was sent to pursue advanced studies in pathology and bacteriology under Professor Welch at the Johns Hopkins Hospital, and in Welch's laboratory made an important investigation of the lymphoid nodules of the liver in typhoid fever (1895). In 1900, Reed was detailed as the head of a board, which included James Carroll, Aristide Agramonte and Jesse W. Lazear, to study yellow fever in Cuba. At this time, it was commonly supposed that the disease was caused by a special micro-organism, the Bacillus icteroides of Sanarelli. Reed subjected this theory of causation to severe tests and soon disproved it. Meanwhile, it had been assumed by J. C. Nott in 1848 and by Carlos Finlay in 1881–6 that mosquitoes are agents in the transmission of yellow fever, and this theory had already been proved to be true in the case of malarial fever by the experimental demonstrations of Ross and others. Reed now proceeded to put this theory to the test, and, with his associates, was able to demonstrate in the most rigorous manner, that yellow fever is transmitted by a special variety of mosquito, the *Stegomyia fasciata,* and not as had hitherto been supposed, by contagion from clothing and bedding or through infection by water, sewage, or other substances accidentally taken into the mouth. To prove this, a number of non-immune persons voluntarily subjected themselves to the bites of mosquitoes which had fed upon known yellow fever patients, or to injections of blood or filtered blood-serum from such patients. Twenty-two cases of experimental yellow fever were thus produced, while seven enlisted men boldly slept in infected bedding without acquiring the disease. Carroll was the first to submit to mosquito inoculation, and sustained an attack of yellow fever from which he recovered. Lazear, who had been accidentally bitten by a yellow fever mosquito, died from the disease. Reed's results were soon confirmed by other observers in Mexico, South America and elsewhere, and the fact that yellow fever is transmitted by a special variety of mosquito alone gave the sanitarian the proper means for pre-

[4] For Lettermann's work, see his "Recollections of the Army of the Potomac" (New York, 1866); also *Jour. Mil. Service Inst.*, Governor's Island, N. Y. H., 1883, IV., 250–287 (B. A. Clements); *Military Surgeon*, Chicago, 1913, XXXII., 221–249 (L. C. Duncan); *Johns Hopkins Hosp. Bull.*, Balt., 1916, XXVII., 243–247 (J. T. Smith).

venting its occurrence. Of this discovery Professor Welch said: "I am in a position to know that the credit for the original ideas embodied in this work belongs wholly to Major Reed." General Wood, who had furnished Reed with the authority and the financial means to carry on his experiments, said:

> I know of no other man on this side of the world who has done so much for humanity as Dr. Reed. His discovery results in the saving of more lives annually than were lost in the Cuban War, and saves the commercial interests of the world a greater financial loss each year than the cost of the Cuban War. He came to Cuba at a time when one third of the officers of my staff died of yellow fever, and we were discouraged at the failure of our efforts to control the disease. In the months when the disease was ordinarily worst the disease was checked and driven from Havana. That was the first time in nearly two hundred years that the city had been rid of it. The value of his discovery can not be appreciated by persons who are not familiar with tropical countries. Hereafter it will never be possible for yellow fever to gain such headway that quarantine will exist from the mouth of the Potomac to the mouth of the Rio Grande. Future generations will appreciate fully the value of Dr. Reed's services.

President Eliot, in conferring an honorary degree upon Reed at Harvard, expressed himself in the same terms.

The task of eradicating yellow fever at Havana fell to Major William C. Gorgas, who became chief sanitary officer of the city in February, 1901, and who put Reed's hypothesis to practical use by the simple process of screening yellow fever patients and habitations, and by destroying the mosquitoes themselves. Inside of three months, Havana was freed from the disease for the first time in 150 years. On March 1, 1904, Colonel Gorgas became chief sanitary officer of the Panama Canal and on March 4, 1907, a member of the Isthmian Canal Commission. When the French began to work on the canal in 1880, Panama was one of the plague spots of the universe. Colonel Gorgas proceeded to take measures for the sanitation of the isthmus on the widest scale, as it was necessary to make the isthmus free from disease before commencing operations upon the canal. The towns of Colon and Panama were in the poorest sanitary condition, with no proper water supply, drainage or sewage systems, unpaved streets without proper gutters, houses sometimes surrounded by water at high tide, infested with rats, the transmitters of bubonic plague, and, in the outlying country, mangrove swamps and areas covered with dense jungle vegetation, underbrush and matted vines, which are a favorite habitat of mosquitoes. Under the French occupation, it was a by-word that every tile laid cost a life. Hand in hand with such prophylactic measures as destroying mosquitoes by spraying with dripping oil upon the surface of still or running bodies of water, making habitations and hospitals mosquito-proof by covering verandas, doorways and windows with woven wire screens, isolating all suspected cases of malarial or yellow fever, administering prophylactic doses of quinine in malarial patients, it was necessary to

clear up and remove all outlying underbrush, a matter of great expense, to pave and gutter every street, to construct mosquito-proof houses, a complete installation for municipal water supply and sewage disposal by piping, to provide every house with modern closets with a pipe-borne sewage system, to fill and obliterate swamps and stagnant pools, to destroy rats as well as unhealthy houses occupied by them, and to disinfect and fumigate the houses contaminated with dangerous diseases. In 1881–9, the French lost 22,189 laborers by death, in other words a death rate of 240 per thousand per year. One station on the old Panama railroad was called Matachin, from the Spanish words *mata,* "killed," and *chin,* "Chinaman," because 1,000 imported Chinamen in houses at this point died off in six months, as also 1,000 negroes from the West Coast of Africa. When the United States took charge of Panama in 1904, the death rate was 40 per 1,000, a yellow fever epidemic raging there from July, 1904, to December, 1905. In less than a year, Gorgas had eradicated it entirely and there has not been a single case since May, 1906. In that year, the admissions to hospitals for malaria were at the rate of 800 per 1,000 workers; by 1913, this rate had been reduced to 76 per 1,000. The death rate from all causes among the workers was about 41 per 1,000; in 1913, it was 8 per 1,000. The general death rate among the total population is now 22–23 per 1,000. The total cost of sanitation has been less than one per cent. of the total appropriation for all purposes. General Gorgas says:

> **When the canal shall have been finished it can be shown that sanitation cost about $365,000 per year. For a population of 150,000 this means an expenditure of about one cent *per caput* per day, and this sum is well within the means of any tropical country.**

Elsewhere he says:

> **I do not believe that posterity will consider the commercial and physical success of the Canal the greatest good it has conferred upon mankind. I hope that as time passes our descendants will see that the greatest good the construction of the Canal has brought was the opportunity it gave for demonstrating that the white man could live and work in the tropics, and maintain his health at as high a point as he can, doing the same work, in the temperate zone. That this has been demonstrated none can justly gainsay.**

In Trinidad, British Guinea, and in all tropical posesssions now inhabited by the white races, the preventive measures used by Ross at Ismailia and by Gorgas at Panama are beginning to be employed. In December, 1913, Colonel Gorgas, at the invitation of the Chamber of Mines of Johannesburg, South Africa, made a scientific inspection to investigate the cause of the high death rate from pneumonia among the native laborers working in the mines of the Rand, a force of some 200,000 negroes. The death rate was 71.7 per 1,000 in 1903 and 26.84 in 1912. Gorgas made a careful survey of existing conditions, concluding that malarial fever, tuberculosis and miners' phthisis also play

an important part in the high rate of mortality and made a number of valuable suggestions for preventing these diseases, such as increasing the floor space of barrack habitations to about fifty feet, the housing of families in huts, the establishment of a central sanitary bureau, the introduction of proper sewerage and water supply, the destruction of flies and other details.

On returning to the United States to assume the office of Surgeon General, General Gorgas was banqueted in London on March 23, 1914, and received the degree of Doctor of Science at the University of Oxford on the same day. Upon presenting him for the degree, Mr. A. D. Godley, the public orator of the university, said:

> Those are most to be honored by us who have increased knowledge and thereby promoted the welfare of the world. Such are many students of medicine: it is a fine thing to have the scientific knowledge which can cure disease; but theirs is a still finer if more dangerous task who can extirpate the causes from which disease springs. It is such men who destroy the seeds of death which are bred in swamps, risking their health and even their lives to serve their fellows. These heroes are a modern realization of the legend of Heracles, the cleanser of foul places and the enemy of evil beasts.
>
> The eminent American whom you see to-day has, like many of his countrymen, fought in the forefront of the battle. His achievements are too numerous for me to relate in detail. Suffice it to say that it is he who cleansed Havana; it is he who put fever and pestilence to flight in the Isthmus of Panama and made possible the long-thwarted construction of the great inter-oceanic waterway; it is he who has recently improved the sanitary conditions of the South African mines. He purified foul air; he waged war on the myriad swarms of death disseminating mosquitoes. The result has been an amelioration of the conditions of human life in plague haunted districts, where once "in silent fear the helpless healer stood," and it is now possible to live in comfort and to work with advantage. There can be no better example of those "whose skill hath served the human lot to raise, and won a name that endless ages praise."

Upon admitting General Gorgas to the degree, the Acting Vice Chancellor, Dr. T. H. Warren, addressed him as: "Preeminently distinguished, sagacious, health-bringing, the modern Machaon of the American Army, whom indeed I should wish to salute not only in Latin prose but also in Greek verse thus:

> Hail Router of the Plague of Flies! Hail Isthmian Conqueror true!
> Gorgas, to that wise Goddess dear, the Gorgon death who slew!

In 1916, General Gorgas spent several months in South America in making a preliminary survey, for the Rockefeller Foundation, of existing endemic foci of yellow fever in that continent.

At the close of the Spanish American War, it was found that more than 20,000 cases of typhoid fever had occurred among our troops encamped within the limits of the United States between May and September, 1898. Major Walter Reed was delegated as president of a board consisting of Majors Victor C. Vaughan and Edward O. Shakespeare, United States Volunteers, to investigate the cause and possible

means of prevention of this plague of encamped armies. After a most careful investigation, it was found that every regiment constituting the First, Second, Third, Fourth, Fifth and Seventh Army Corps developed typhoid fever, that more than ninety per cent. of the volunteer regiments developed the disease within eight weeks after going into camp, that typhoid fever is disseminated by the transference of the excretions of an infected individual to the alimentary canals of others, that camp pollution was a more prominent causal agent in this instance than contaminated water supply, and that the disease was mainly disseminated by flies, on the clothing of human carriers, by dust, and by infected bedding and tentage. Wholesale disinfection of excreta and all other possible sources of infection was recommended, also sterilization of water supply, raising of soldiers' beds from the ground, removal of troops from infected sites and proper policing of new sites, liberal spacing between tents and the men inside them and more correct diagnosis of typhoid by army surgeons, only about one half the actual number of typhoid cases being correctly diagnosed in this instance. In this epidemic, the deaths from typhoid were 86.24 of the total deaths, the morbidity from typhoid was 192.65 per 1,000 of mean strength, the mortality was 14.63 per 1,000 mean strength, in a group of soldiers numbering 107,973 men. The investigations of Reed, Vaughan and Shakespeare attracted wide attention and their recommendations became of great use to army surgeons. We may contrast the figures given by Reed with the results obtained by Major Frederick F. Russell during the mobilization of United States troops on the Mexican border in 1912. Prior to this date, preventive inoculation against typhoid by means of a specific vaccine had been made practicable and successful by Chantemesse and Widal in France, Sir Almroth Wright in England, and others, and in 1909, Major Russell began the gigantic experiment of vaccinating the United States Army against typhoid. From a morbidity of 173 cases in 1909, he was able to bring his statistics down to 9 cases of the disease with one fatality in 1912. At present the army is absolutely free from typhoid. During the Mexican mobilization, Russell vaccinated some 20,000 men against typhoid, the only case occurring in camp being that of a non-vaccinated teamster. As typhoid fever has the reputation of destroying more men in war time than the enemies' bullets, the significance of these statistics needs no further elucidation.

During the American occupation of Porto Rico, it was found that smallpox was endemic there, as it has been in all Spanish American countries. It was said that the people thought little more of smallpox than of an attack of prickly heat. In December, 1898, the incidence of the disease assumed such proportions in the island that an epidemic was threatened. In January, 1899, the reports of the post surgeons for

November and December showed that 3,000 cases had been noted in this short period. Thereupon, by order of Governor General Davis, the entire population of the island, including infants under six months of age, was vaccinated under the direction of the Chief Surgeon of the Division, Major John Van R. Hoff. As an experience of six months had shown that all virus from the United States lost its virility on reaching the island, a vaccine farm was established at Coamo Springs, under the successive commands of Major Azel Ames, U.S.V., and Captain F. P. Reynolds, U.S.A. Cattle were abundant, being obtainable at one dollar per head, and with the cooperation of the native physicians and the local alcaldes, the work was soon accomplished. In spite of the difference in language and customs of the people, the constantly recurring rains which frequently made the mountain streams impassable, the lack of hotels and other accommodations in the country villages, no less than 800,000 persons were vaccinated in three working months and by October 1899, there was not a single case of smallpox known to either the military or civil authorities. The total cost of ridding the country of the disease was $32,000, or about four cents for each person vaccinated. In like manner, Colonel Hoff stamped out leprosy in the island, by segregating the patients in a leper colony.

In 1900, Captain Bailey K. Ashford discovered the presence of hookworm infection in the island, and shortly afterward, it was found to be very prevalent among the rural population of the southern states of this country by Dr. Charles W. Stiles, of the Public Health Service, who found that the American variety of the specific parasite of the disease is a new species. Captain Ashford has devoted himself to the task of stamping out hookworm infection in Porto Rico, having treated some 300,000 patients in 1903–4, and having reduced the mortality by ninety per cent. He is now engaged in the study of the causation of tropical sprue in South America.

In the Philippines, Captain Charles F. Craig demonstrated that intra-corpuscular conjugation in the parasites of malarial fever is the cause of latency and relapses of the disease, and that there are malaria carriers, that is persons who carry the malarial parasites about with them without being affected by the disease. In 1906, Craig discovered a new parasite connected with the dysenteric infections, the *Paramœba* (now called *Craigia*) *hominis*, and is the author of valuable monographs on the malarial fevers (1901, 1909) and the parasitic amœbæ in man (1911). With Major Percy M. Ashburn, he discovered another parasite, *Microfilaria philippinensis*, in 1906, and demonstrated that the cause of dengue or break bone fever is a filterable virus transmitted by the mosquito *Culex fatigans* (1907).

In the Philippines also, Captain Edward B. Vedder made important investigations of beri beri, a tropical form of neuritis which has been

attributed to a too exclusive diet of highly milled or polished rice. It was found that the disease is what is now termed a "deficiency disease," that is one caused by a diet deficient in certain substances necessary to the physiological economy of the body. This was conclusively proved by Vedder and his associates, after a careful investigation of the pathology of the disease in fowls as well as man. It was shown that beri beri can be eradicated in the native Philippine troops and scouts by a simple change of ration, substituting under-milled for polished rice, that the disease can be experimentally produced in puppies and fowls, and that the administration of an alcoholic extract of rice polishings to infants suffering from beri beri will alleviate some of the symptoms of the disease It is recommended that under-milled rice be substituted for the polished variety as a food staple for the poorer classes wherever possible. All these results have been admirably summed up in Captain Vedder's recent treatise on beri beri (1913) which is the latest and most exhaustive work on the subject. Captain Vedder was also the first to determine that emetine has a specific amœbicidal action in amœbic dysentery (1910–11), which fact was speedily translated into action by Sir Leonard Rogers, and others.

When Ehrlich announced the discovery of his new remedy for syphilis ("606"), Captain Henry J. Nichols of the army collaborated with him in trying out the drug in the early stages of its investigation, and shortly after, Surgeon General Torney issued a circular giving directions for its use in the army. Since then, Captain Nichols has continued his valuable researches on the treatment of syphilis and has investigated the experimental production of the tropical disease "yaws" or frambœsia (1910–11).

Major Eugene R. Whitmore established the Pasteur Institute at Manila (1910), made investigations of rabies and tropical dysentery, and served on the Yellow Fever Commission (South America) in 1916.

In 1911, Drs. E. R. Gentry and T. L. Ferenbaugh discovered that Malta fever is endemic in Southwestern Texas, in connection with the goat ranches, demonstrating these animals to be the agents of its transmission.

Major Weston P. Chamberlain has made important investigations of hookworm infection, diphtheria, Vincent's angina, typhoid fever and beri beri in the Philippines, and collaborated with Captain Vedder in his work on beri beri.

Lieut. Colonel Charles E. Woodruff (1860–1915), retired, late editor of "American Medicine," made highly original investigations on the deleterious effects of tropical light on the blonde races, and has published several volumes, including "The Effects of Tropical Light on White Men" (1905), "The Expansion of Races" (1909) and "Medical Ethnology" (1915) which have had an international circulation and reputation.

Captain Arthur C. Christie is the author of the latest and most up-to-date book on X-ray diagnosis (1913).

The recent treatise of Colonel Louis A. La Garde on gunshot wounds (1914) is, in connection with the present war, the book of the hour. Colonel La Garde was the first to point out that microorganisms are not destroyed, when placed in gun powder or on projectiles, by the act of firing (1892). Up to the time of his first publication on the subject, the idea had prevailed that the heat of ignition in the explosion and that conveyed to the bullet at the time of firing was sufficient to disinfect both, and that powder grains and bullets were made sterile after leaving the gun. By means of extensive experiments, conducted in the laboratories of the Johns Hopkins Hospital, on inanimate matter and animals, he was able to show that earlier notions of the subject were erroneous, and that both powder and projectile, when primarily infected by virulent organisms, like the bacilli of tetanus or anthrax, and shot into animals at all ranges up to five hundred yards, still carried these organisms, conveying the diseases to susceptible animals struck by them with the usual fatality. These experiments which are fully described in Colonel La Garde's Mütter Lecture on Poisoned Wounds by the Implements of Warfare, delivered before the College of Physicians at Philadelphia in December, 1902, soon prompted surgeons, military and other, to be more thorough in the treatment of gunshot wounds. Such a thing as a sterile gunshot wound is no longer advocated and the greatest care was thereafter taken to rid such wounds of septic matter introduced by the act of firing. These and other writings have given Colonel La Garde a wide reputation as a recognized authority on military surgery. In 1892, he was detailed as the medical member of a board of army officers to determine the best type of rifle and ammunition to be selected in changing the armament of the United States Army. His advice was of great value to the Government in selecting the kind of weapon which has since been in use by our foot and mounted troops.

Col. Jefferson R. Kean as Chief Surgeon of the Cuban Army of Pacification did yeoman service in the prevention of infectious diseases in that island, and is now director of the Red Cross and base hospital establishment.

The manuals of military medicine by Charles S. Tripler (1858), General Alfred A. Woodhull (1898), and Lieut. Colonel Paul F. Straub (1910), also the manual of military hygiene by Colonel Valery Havard (1909) are highly esteemed in the medical corps.

Lieut. Colonel Edward L. Munson, editor of the new *Military Surgeon* (1916), devised the Munson shoe for troops (1912) and has written valuable treatises on military hygiene (1901) and sanitary tactics (1911), the former having been a text-book in the British as well as the American army.

Dr. Joseph Y. Porter, Lt. Col., retired, has made a national reputation as State Health Officer of Florida which office he has conspicuously adorned for many years.

Among those who have made reputations outside the medical sciences are Dr. Elliot Coues, deceased, Major James C. Merrill, deceased, Captain Robert W. Shufeldt, retired, who have international renown as ornithologists, Lt. Col. Edgar A. Mearns, deceased, who accompanied Colonel Roosevelt to Africa, and was one of the leading ornithologists of the world; and Major Washington Matthews, deceased, who made important contributions to the science of anthropology, particularly to the folk-lore of the Navaho Indians. Major James Evelyn Pilcher (1857–1911), editor of the *Military Surgeon* (1907), wrote a valuable series of biographical memoirs of the Surgeons General of the Army (1905).

The administrative successors of Colonel Billings as Librarians of the Surgeon General's Office were Lt. Col. David L. Huntington, Major James C. Merrill, Major Walter Reed, whose achievements have already been referred to, Colonel Walter D. McCaw, who created the historical collections in the library, wrote the treatise on "Tropical Surgery" in Keen's Surgery, and is now Chief Surgeon on the Mexican Border, and the present incumbent. Among the recent medical archivists of the army medical establishment, Major Louis C. Duncan has made valuable medico-military studies of the battles of the Civil War (1912–14) and Lieut. Fielding H. Garrison (Medical Reserve Corps), editor of the *Index Medicus,* has contributed extensively to medical bibliography and medical history.

The Army Medical Corps has contributed to the line of the Army Major General Leonard Wood, late Chief of Staff, and to the staff Major General F. C. Ainsworth, late Adjutant General. The work of General Ainsworth in the reorganization of the Record and Pension Office, and of General Wood in Cuba and elsewhere are known to all.

Army surgeons of other nations include such great names as those of John Hunter, Sir Joseph Fayrer, Charles Murchison, Sir Ronald Ross, Sir David Bruce, Sir William B. Leishmann and Sir Leonard Rogers in England, the Langenbecks, the elder von Graefe, Dieffenbach, Stromeyer, Helmholtz, Cohnheim, Löffler and von Behring, in Germany, Laveran and Widal in France, and Pirogoff in Russia, and in variety of accomplishment, no doubt the Medical Corps of the United States Army is equalled, if not surpassed, by the work of the Indian Medical Service of Great Britain But, in preventive medicine, we believe that the scientific achievement of our Medical Corps is unequalled by that of any other army of modern times.

THE ECONOMIC SAVING OF HUMAN RESOURCES

By C. L. CLOSE

MANAGER BUREAU OF SAFETY, SANITATION AND WELFARE, UNITED STATES STEEL CORPORATION

THERE was a time not long ago when employers paid little attention to the welfare of employees. Plants were built and machinery installed with a view to economy of space and volume of production. Little thought was given to the conditions under which employees worked. The industrial pioneers in this country couldn't consider the wear and tear on human bodies. They were too busy developing processes and striving to become leaders of the world in manufacturing.

We stand first among the steel-making nations of the world to-day. The first furnace for smelting iron in the United States was built on the James River in 1621 by Englishmen under the guidance of John Berkeley. Their problem was that of the pioneer. The industry was new, the country undeveloped, the Indians hostile; guns were an important part of the equipment at the furnaces. But, not until fifty years ago, after the Civil War, were the activities started that have made this country the leading nation of the world in the manufacture of steel. It required men of courage for work of such magnitude. They perfected in fifty years an industry employing over half a million of people and producing annually more than ten hundred million dollars worth of the material most essential to our civilization. Over and over again these men risked all they had in the world, lost everything and afterward won back more than they had lost.

They had many problems to face, these pioneers, while they were performing the herculean task of developing this gigantic industry. Considering the difficulties under which they labored, should we not temper our criticism of them for failing to consider the finer details of the human side of steel making? Let us see what the large corporations are doing to solve the present day problems—particularly the United States Steel Corporation.

It is the task of the present generation to prevent accidents, to ward off disease and to promote social welfare. We shall make mistakes just as the preceding generation did, and it will fall to the next generation to correct our mistakes, as we have corrected some of the mistakes of our predecessors. The opportunity for study and experiment is much better to-day, and as we become enlightened our standards will be raised. Some things that are being done to-day, which may be considered in advance of the times, will, in a short time, be accepted as

nothing out of the ordinary. Not many years ago it was unusual for a plant to have toilet and washing facilities. To-day, no manufacturer would build a plant without including these things, as an essential part of the equipment. It is only because we are becoming more enlightened and are discovering things which those before us had neither the opportunity nor the time to discover.

Not until 1900 was it definitely proved that yellow fever can be transmitted only by the mosquito; and the elimination of this cause of yellow fever made possible the building of the Panama Canal. The inoculation against typhoid fever will work wonders in the saving of human lives, and this was unknown but a few years ago. Wonderful and important discoveries and changes have been made, such as, wireless telegraphy, telephone, electric light, heat and power. We have better opportunities for education; even our methods of education are changed. I can remember the day, and no doubt some of you can, when it meant punishment for a boy to be caught using a jack-knife on the school premises; to-day, many schools have manual training courses, and before long a school without such courses will be thought obsolete. These courses were not provided in the past because their value was not understood. Understanding has come only through study and investigation.

Many things are being done in the corporation which may be considered innovations, and it may be that we are making mistakes, but we are just now going through the experimental stages of some of this work, and it will fall to those who come later to correct them. While in recent years some thought was given to the human side of steel-making, and various attempts were made to improve conditions, there was no concerted or systematized effort until after the formation of the United States Steel Corporation.

Organization

In order to systematize and standardize the work that was being done by the subsidiary companies, the Steel Corporation, in 1906, appointed committees to study these matters. A safety committee was appointed, consisting of representatives of the larger subsidiary companies, who had already given some study to the subject of accident prevention. This committee now meets four times each year, conducts inspection by sending men from one company to another company's operations; studies serious accidents and recommends measures to prevent the recurrence of such accidents in any of the plants; passes upon safety devices and makes recommendations as to their use.

The good resulting from the work of this committee led to the appointment of other safety committees, including the central committee of safety for each subsidiary company, composed of representatives from the different plants of the company; its duties are similar to those

of the Steel Corporations Safety Committee, but with reference to its particular company only. There are also plant committees, composed of important officials of the plant; whose duties are similar to those of the Central Safety Committee, but with reference to their particular plant only. And there are department and special committees, made up of foremen, master mechanics and skilled workmen, who investigate particular problems, and workmen's safety committees from the rank and file of the mill, including even the foreigner who can not speak English. Their duties are to look for dangerous conditions and to recommend ways and means of preventing accidents. Members of these committees, especially of the plant committees, are changed frequently so that in due course each man in the plant shall serve upon the committee. Up to the present some 13,000 employees have served upon these committees and there are now 4,249 men so serving.

Accident Prevention

The results of the work on accident prevention have been very gratifying. Our serious and fatal accidents are about one half of what they were in 1906. We have saved since that time 14,967 men from serious or fatal injury. Approximately, five and one half million dollars have been spent in providing safeguards. Our efforts to-day are to educate our workmen in safer methods of work and to warn them against certain practises that are not only unnecessary, but often foolhardy. They had come to believe that "chance-taking" was a necessary part of their work.

First Aid and Rescue

Recognizing the fact that with the utmost care and the protection afforded by the most approved safety devices and apparatus, accidents will occasionally happen, the subsidiary companies have made provision for prompt attention to injured men and skilful care of them.

All the mining companies of the corporation have first aid and rescue crews composed of employees who are especially trained for the work. This service is purely voluntary on the part of the employees, but before any man is allowed to enter the work, he must have a doctor's certificate showing he is physically fit for the training and labor incidental to it. The system varies slightly in each company, but the general plan is as follows: Four to six men are assigned to each crew. They meet periodically and are trained by the company doctor. The course consists of lectures, demonstrations and drills. Twelve lessons are usually required to complete the course, and each man is given a certificate after he has qualified. The training of the men for the work goes on continually and many new crews are added each year. A number of crews are assigned to each mine.

At many of the manufacturing plants of the subsidiary companies

of the corporation men are trained in first aid work. The training is similar to that given in the mining companies. The primary object of first aid is to furnish an aseptic or clean dressing that will prevent infection in the wound.

As a necessary adjunct to first aid and rescue work in both mines and mills, emergency hospitals, completely equipped, have been provided. All cases of injury, no matter how trivial, are sent to the emergency hospitals or stations, where treatment is given by competent surgeons or trained nurses. Whenever the accident is of a serious nature, the injured man is taken to the emergency station, where first aid treatment is administered, and he is then transferred to the nearest hospital.

Relief

Also recognizing the fact that the burden of caring for the injured should be borne by the industry, the steel corporation established a voluntary accident relief plan, which was put into force before any such system had become law in the United States. This plan is purely voluntary and was put into operation by the corporation in May, 1910, and is for the benefit of all employees injured and the families of employees killed in the service of the subsidiary companies. The funds required to carry out the plan are provided by the companies, with no contribution whatever from the employees. Relief is paid regardless of legal liability and without legal proceedings; even application for relief is not required. This plan of relief is still in effect in those states where workmen's compensation laws have not been enacted. The amount paid in 1915 to and for our injured workmen, including expenditures both under our plan and Workmen's Compensation Laws was $1,694,465.29, or 85 per cent. of our total expenditures, on account of work accidents was paid out to the injured men and their families, or in taking care of them.

Sanitation

The work in sanitation has been organized in a manner almost identical with the safety organization, except that the sanitation committee is chosen from the presidents of the subsidiary companies with an officer of the United States Steel Corporation as one of its members. This committee administers the work through a subcommittee composed largely of technical representatives from each of the subsidiary companies.

In sanitation many improvements have been made in the proper investigation and observation of water supply and distribution to the employees. All sources of drinking water are analyzed periodically and great care is taken to prevent possible pollution by surface water or otherwise. The most modern sanitary methods are employed in the

cooling and distributing of the water, including the installation of sanitary drinking fountains—the common drinking cup has been practically eliminated.

The common or roller towel was abolished several years ago. The committee has prepared specifications covering general sanitary requirements and these are followed by the subsidiary companies when installations are made. An important requirement in these specifications is that no wash basins shall be installed. Facilities for washing the face and hands shall be such that employees must necessarily wash from the flowing stream. This may seem radical, but we think it important, in order to avoid any possible danger of spreading disease. Good toilet facilities have been installed at many plants and mines—these facilities usually including shower baths. A number of swimming pools have been built for the general use of the people in the mining towns.

In Alabama, where one of our mining companies conducts its operations, the conditions are favorable to mosquito breeding. The Tennessee Coal, Iron and Railroad Company especially, are doing much to prevent the spread of malaria fever. Streets and alleys are properly drained; pools and lowlands are drained or filled in, where practical; otherwise they are covered with crude petroleum. All known methods of fighting the mosquito are used. By these methods the number of cases of malaria fever has been greatly reduced, and the comfort of the people living in our camps has been increased. Over 200,000 circulars, explaining the dangers from the fly, were distributed among our employees last summer. This circular was written in simple language, easy to understand.

Metal garbage cans equipped with tight fitting covers are placed at the rear of each house in the mining camps, and at convenient places throughout the mills. Garbage and other waste materials are collected periodically and burned.

Some of the subjects of which the sanitation committee is now making a study are occupational diseases, mine sanitation, proper ventilation in plants and company houses; provisions for proper heating and lighting systems in plants; provisions for regulation of milk supply; dust removal at plants, including roadways.

Housing

In the ore mining regions of Minnesota, the ore and coal regions of Alabama, and the coal-mining sections of Pennsylvania and West Virginia, very satisfactory results have been attained in the housing of employees.

In the populous centers, such as Pittsburgh and Chicago, where

many corporation mills are located, the employees are merely a small portion of the city's population and are provided for in the ordinary way in which a city's people are housed, without the intervention of their employers. In such cases intervention by the employer would appear inadvisable, if not actually impossible. Where great plants have been built at some distance from any city, as in the cases of Gary and Duluth, the corporation has been obliged to provide houses for such large numbers of its employees that it has built industrial villages adjoining the plants.

It is believed the essential provisions of water supply, sewerage, lighting and other requirements for the public health of these towns can not be fairly criticized. The housing provided by the corporation in these towns is perhaps better suited to the needs of the skilled workmen than to the wages of the unskilled workmen. This is but natural, since the organization of the new plant demands first of all a force of skilled men, who must be drawn from older plants where they have established their families. In order to induce them to come to the new plant, provisions for housing them must be fully worked out beforehand, because they will not come and even temporarily shift for themselves, as the unskilled laborers, largely foreigners without families, are accustomed to do in the beginning. Furthermore, no industry in this country has, so far, solved satisfactorily the problem of housing unskilled foreign laborers, whose families have not yet followed them to this country. These men earn low wages, out of which they seek to save the utmost amount possible. They have been accustomed to ways of living which we must try to change, but which are much cheaper than those ways in which we wish to have them live.

In the hope of evolving some satisfactory method of housing these unskilled workmen, the corporation is now studying three types of houses.

First: Houses for occupation by families only, which can be rented for not more than $2.00 per room per month.

Second: Houses for occupation by families which follow the general custom of taking boarders, such houses to be especially adapted for that purpose, so that the family quarters may be apart from those of the boarders.

Third: Dormitories or barracks for men without families, where each man shall have a separate and sanitary room, however small and bare it may be, with common mess rooms, shower baths, etc.

We expect our new town, known as Morgan Park, Duluth, Minnesota, which is now being built to house the employees of the Minnesota Steel Company, to be one of the finest industrial towns in the country.

Gardens

In order to promote more healthful and pleasant living conditions, the subsidiary companies owning houses in which their employees live, have offered prizes each year for the best vegetable and flower gardens. Last year there were 6,963 of these gardens in the Frick Coke Company towns alone—95 per cent. of the total number that could have been planted. The estimated average value of each vegetable garden was $21.48, based upon the prices at which garden produce was sold by the stores in that vicinity. There were 6,633 vegetable gardens and this meant a saving to the employees of that company of $142,536.21. To further encourage thrift, the Tennessee Coal, Iron and Railroad Company in Alabama, where, because of the long season, a large proportion of its employees have mid-summer gardens, now offers prizes for the best gardens inspected in October. The climatic conditions in Alabama are more favorable to fall gardens than in any of the other localities in which our plants and mines are situated. Some of the companies have utilized the vacant land near their plants for community gardens. The ground is usually plowed at the expense of the company, and is then plotted and turned over to the employees for their use. Prizes are offered for the best gardens. Usually the amount of land allotted is insufficient to accommodate all those who desire to cultivate these plots.

Clubs

Many of the subsidiary companies have provided commodious and well-equipped clubhouses for the use of their employees, members of their families and friends. The features are:

Dormitories, reading room and library, gymnasium and swimming pool, baths (tub and shower), auditorium and dance hall, billiard and pool rooms, bowling alleys, basket-ball halls with motion pictures, lectures, concerts, smokers, musicals, etc.

The subsidiary companies pay all taxes and insurance and furnish heat. All other expenses are borne by the club members, the initiation fees and monthly dues being very small. In some cases these dues are fixed in proportion to the wages of the men.

Reading rooms are supplied with the current magazines and periodicals, daily papers and a good assortment of books. The social entertainments are a feature of the clubs. The affairs of the clubs are handled by the members themselves, in the usual way. Intoxicating liquors and gambling are prohibited.

Stock Subscription Plan

On December 31, 1915, more than 40,719 employees were stockholders under the stock subscription plan inaugurated in 1903. Their aggregate holdings are more than 178,898 shares of a par value of

$17,889,800. It is impossible to ascertain how many employees, in addition to those yet receiving the special benefits that continue for five years, hold stock upon which these special benefits have ceased to be paid, but it is believed that the number would greatly increase these figures.

Pensions

The United States Steel and Carnegie Pension Fund, which was established in 1910, by the joint action of the United States Steel Corporation and Mr. Andrew Carnegie, had a record of 9,002 pensioners on December 31, 1915. The amount paid in pensions during 1915 was $659,389.42.

Welfare

In welfare work of a character not already mentioned for the benefit of the workmen, the subsidiary companies are trying many interesting experiments, some of which have already proved very successful, and it is hoped that the others will be equally successful, so that the work may be further extended.

One of the most practical and successful of the new departments developed in connection with the welfare movement is that devoted to gardening and nature study. This department was inaugurated at the Duquesne Works of the Carnegie Steel Company during the summer of 1914, and the results were most encouraging. The principal gardens were conducted in connection with the Water Street Playgrounds. Here a number of old houses were removed, and the area vacated was apportioned into 144 small plots of 8 x 10 feet—and each plot allotted to a boy or girl. The children, aged 8 to 14 years, and representing ten different nationalities, were under the direction of a trained instructor and were given daily lessons in garden making. Each garden was planted with beans, beets, carrots, radishes and lettuce; and the actual labor of planting and caring for the gardens was performed by the children themselves. The little gardeners utilized the crops for home consumption, or sold them and used the money for their own purposes. In addition to the regular care of the gardens, the children study the germination of seeds. First, the development of the seedlings, showing the transformation of the dry seed into a living plant, which breathes, eats and grows just as human beings do. This gives an insight into the wonders of the living world, satisfies the natural curiosity of childhood and affords much pleasure.

Study of methods of planting is also insisted upon. The children are taught the necessity of a knowledge of the life and habits of the plant and are shown the results of right and wrong planting. Methods of cultivation are touched upon, and the result of each method is shown. Methods of fertilization follow in succession with demonstrations of the results of each method and practical advice as to the proper method to

be selected. Then comes the study of systems of irrigation and the conservation of soil water, showing the means employed and the effects produced. This is followed by study of the various functions of the plant.

Visiting Nurses

Visiting nurses are employed by the companies in a number of districts. Ordinarily they are under the direction of the local company physician or plant manager, although in some cases they are under the supervision of city visiting nurses' associations. Their duties are to visit the homes of employees, especially where there is sickness and the family would be benefited by the assistance or instructions of a trained nurse; to render such aid as will conduce to the comfort and welfare of the families; to instruct and direct mothers in the care and feeding of infants. These nurses explain the proper preparation of all food and advise in the matter of economical purchasing, discourage anything and everything tending to immorality, and teach the value and necessity of cleanliness and the benefits of fresh air and sunshine. Some of these nurses have been provided with a house which we call a "Practical Housekeeping Center"—a house of the ordinary type in the locality, furnished in a manner not beyond the means of the lower paid workmen, but in a better style than they had been accustomed to, before coming to this country. This house is used as the nurse's headquarters. Here she conducts classes and teaches the women and girls in the neighborhood the art of housekeeping in a practical and sanitary manner.

Playgrounds

One hundred and thirty-seven playgrounds for children have been provided by our subsidiary companies. In most cases they are on the company's unused land, and in some cases they are on city or private property, but the grounds are usually prepared and equipped at the expense of the company. Competent instructors employed by the company are in charge of the grounds. In addition to playground work, some companies provide instructions in sewing, basketry and handicraft. Motion pictures, both for instruction and amusement, are shown at night to parents as well as the children. Last summer there was a daily average attendance of 18,000 children at these playgrounds. Where these grounds are installed, it is immediately apparent that the standards of the children are raised. It is impossible to overestimate the influence for good exerted by these recreation features on the future lives of the boys and girls of the community in which they are located.

Educational Work

For many years the companies have been carrying on educational work among their employees, including vocational training and appren-

ticeship classes, and the teaching of English to foreigners. The purposes are:

To increase the efficiency of the workmen by teaching the fundamental and the more advanced principles involved in their individual lines of work.

To increase the earning power of the pupils by guiding them along the paths of quicker and deeper reasoning which lead to positions of gradually increasing responsibility in all departments of the mill.

To promote and develop the happiness of the pupils not only in their daily work in the shops and mills but in their home life as well by opening the door to a more thorough understanding of the meaning of life and work.

The courses are varied to meet the needs of every employee who is desirous of advancement, whether he is the graduate of a university or a man who has had no special school advantages. The teachers are men actively engaged in their respective lines, either in the mills or in the city. These men are selected because of their scholarship and broad practical experience in the branches they teach. The majority are assistants or foremen in the various departments of the mills, and, therefore, are personally acquainted with many of the students in their classes, which results in an increased mutual benefit. Actual mill problems are considered and studied in each step of the work as it is taken up in the prescribed courses, with the result that each pupil not only learns the principles involved in his own special line of work, but also those that must be understood before he is qualified for the position ahead.

Special and attractive inducements are offered to those who finish the courses.

The method of teaching English to the foreigners is usually that recommended and used successfully by the International Committee of the Y. M. C. A. in various industrial localities. The majority of the foreigners upon entering the school can not speak, read or write the English language. They are first taught simple English sentences and the names of objects with which they come in daily contact; then follows instruction in letter writing, and the filling out of money order blanks and naturalization papers. They are taught the elements of civil government; and the plan of the county, state and national governments, their departments, and the names of important officers and offices are carefully explained to them. The advanced pupils are taught writing, spelling, grammar, composition, civics and arithmetic; books on American history and geographical readers are used as text-books.

EDUCATION, EFFICIENCY AND ECONOMY, WITH SPECIAL REFERENCE TO MINING

By LANCASTER D. BURLING

CANADIAN GEOLOGICAL SURVEY

WE have all had an education, whether we got it within natural or artificial walls, as a measure of growth with our growth in the rough and ready school or in doses identical with the other members of a class in the school whose courses are served to some according to prescribed formulæ, to others as a table d'hôte meal, from which they can "elect" the things they want. Unless our education has received a "continental" finish, however, we have never had the opportunity of tasting the courses on the intellectual menu before we ordered.

Academic reform was a topic of the day during the years immediately preceding the fall of 1914. In the present days of stress it is a vital problem, for economy has now become a necessity, true economy is impossible without efficiency, and efficiency is a matter of education. Since any economy or efficiency which ignored our second ranking industry would be farcical, mining education has become and must continue to be an object of primary concern.

After previous wars, and with less of economic necessity, the world has forgotten; after this war necessity and the operation of that universal law which ever tends to minimize external friction will soon tear down reprisal barriers, unless, indeed, the better sense of nations fails to raise them, but a long period of adjustment must succeed the final restoration of international comity. That economic necessity will weigh upon the world with a vigor previously unsurpassed is indicated by the words of Mr. Asquith at the beginning of the year 1916:

> **The nation's liabilities have already reached a figure which staggers the imagination and will strain its resources for a generation.**

It is for our educational institutions to see to it that this scourge of economic necessity shall be beneficial, for we are convinced that intelligent direction will give it this effect.

If we are to hold our own in the period of industrial rivalry that is to come we must utilize our brain power. We must realize that pure research, though carried on without regard to gain, is the best investment a nation can assume, for its returns are certain and may be incalculably great. We must realize that science leads and its discoveries can not wait on industry. The phosphorus iron ores which mean so much to central Europe lay fallow until an English chemist solved the problem of converting them into steel. The constructive and the creative must replace the imitative—prevision must replace contemplation—qualities of youth, and we are young. But we shall need the leadership of men who believe in the principle laid down by Disraeli:

Economy does not consist in the reckless reduction of estimates; on the contrary, such a course almost necessarily tends to increased expenditures. There can be no economy where there is no efficiency.

The penalty a democracy has to pay for being a democracy is the fact that the good of the majority must wait upon its will. But the progress of the race demands a minority intelligence that shall "scorn the decisions of an unjust majority," a minority intelligence in whom the better ideas shall originate and in whom there is a willingness to carry to the extent of personal sacrifice the education of the electorate.

Several million voters will have been doing for months what they were told to do. Why? Because the men who told them knew. Well, when our men of science tell us what we ought to do, let's do it. It is hard to believe that men who have taken life at the command of an officer will not vote for the conservation of life at the request of a scientist; that men who have mined trenches for the purpose of producing casualties in the enemy will need encouragement to prevent casualties in their own ranks in the mines of peace; that men who have been part and parcel of an organization which depends on the scrutiny of detail, thorough preparation and purposeful procedure will tolerate the absence of this scientific attitude in the days of peace; and that men who are physically unfit through the accidents of war will not realize the necessity of developing and conserving the physical fitness of a people. It is for us, individuals or nations, who are not participating in the baptism through which they are passing to see to it that we shall not be the ones to clog the wheels of progress. Let us realize that we shall never act for the good of all until we master the problem of acting for our own good, and that we are masters of more than our own destiny. Nations are a people in partnership and we are each responsible for our share.

The involuntary chemicalization that is going on in the body politic of the world presages a crystallization that will not be content with other things as they have been. The best brains of our educational men should be organized now for a voluntary chemicalization of our own, that we may crystallize a scheme that shall bear the acid test of the coming years, for test there will be, and the best results for education will come if this chemicalization goes on under the proper control rather than under the stress of immediate necessity. Sudden readjustments are dramatic, but quiet preparation now for what is going to happen next year, five years from now, or a generation hence, is the thing that counts. In the words of President Eliot:

Nature's patient ways shame hasty little man.

Whether or not the life work of many of our graduates is to follow closely the lines for which they may have trained the engineering which they receive should be a practical habit of thought rather than a specific fund of knowledge. The opposite viewpoint receives abundant confirma-

tion, however, in the establishment, among the universities of North America, of 85 separate and distinct degrees in engineering, 63 undergraduate and 22 postgraduate. The same tendency is to be observed in the number of courses offered to the students of our schools, but it has seldom reached the degree of absurdity obtaining in the University of Pittsburgh. Fiction pales before the truth of the following paragraph from the eighth annual report of the Carnegie Foundation:

> **The catalogue of the University of Pittsburgh gives the names of a dean, a professor, and three instructors who offer one hundred and fifty-six courses in geology; three of the five offer also ninety-two courses in crystallography, mineralogy and lithology, and sixty-three courses in petrography; two of these three offer also two hundred and forty-three courses in mining geology; one of these two also bears one half the burden of one hundred and sixty-two courses in ceramics; of the remaining two of the five, one bears also one half the burden of one hundred and five courses in paleontology and one also offers sixty-three in paleobotany. Together these five men announce, probably in addition to other work in other parts of the university, a grand total of seven hundred and fifty courses, one of the five, an instructor, being alone responsible for two hundred and eighty-five. Even though all of these courses were announced for a single term only, these men would each have to give from forty to seventy courses at one time, which is preposterous.**

Such a condition would convert almost any one to the opinion expressed by Professor J. C. Brown, of Liverpool:

> **It would be far better to teach one science subject substantially and well than to teach a smattering of several.**

If a defendant of our present system of technical education were to ask me then to explain the efficiency of our engineering courses, I should say that it is to be ascribed almost solely to the fact that for four years the mental powers of the student are taxed to the limit.

You hear it said: "Mining schools are here to teach mining, not to develop culture." However defensible the stand that our universities should develop culture, their present danger is one of even neutralizing the cultural effect of a student's previous training by a system of too close application to the purely technical. But it is not so much what we study as how it is taught.

Our mining schools are not aiming at the production of well-educated or particularly skilful miners, but engineers—a difference that is expressed in terms both of mental processes and methods of attack—and the number of men in training should have little to do with the number of vacant jobs. As long as mining is carried on, so long will there be a demand for trained men, and the demand will be proportional to the supply just as far as that supply is efficient. To paraphrase a sentence from Perkins' "Some Things to Think About": What we need to-day is mines managed by engineers, not by opticians or milliners who happened to get side-tracked while they were in college.

True education bridges the gap betwen the mechanic and the engineer, the imitative and the creative—it is a process which is successful

to the degree in which it prepares a man for the responsibilities of a citizen and can not be measured solely by his success as a mine manager. How then are we to explain the failure of the mining engineer either to assume or to be accorded his proper place in the commonwealth of civil effort? Placing the blame for such a condition upon our own indifference is unsatisfactory, because it ignores the source of that attitude and gives us no assurance that the next generation shall not be as indifferent. Graduation from our mining schools should not be possible to any man who does not appreciate the economic value of a miner, who is not a conservationist to the backbone, who does not appreciate the fact that unlike forestry and some of the other things we hear so much about, human industry has had nothing to do with the production of the heritage which he is to exploit; that it is both expendable and irreplaceable. He must be endowed not only with "superior professional efficiency," but with those qualities which will enable him to cope successfully with the larger problems of our time. We hear a great deal about making our college courses such that our graduates will be adjustable; well, being adjustable bears about the same relation to human progress that watching a baseball game does to physical development. We need men who can and will do some adjusting themselves. Mann believed that one former was worth a thousand reformers; what would have been his ratio between formers and conformers?

Where do we stand and what can we do? And let us not be concerned so much with the level of our attainment as the direction of our going.

When we are told that the miners of the United States mine five times as much coal per day as do those of Belgium, we want to know why. Is it due to efficiency or is it due to the fact that the United States miner is allowed to waste a ton and a half of coal for every three which he sends to the surface? A ton and a half for every working day of every man in an army of three quarters of a million men. Or does the Belgian waste as much?

Why can a Nova Scotian mine over three times as much coal in a day as a Belgian? Has the difference in speed any bearing on the fact that the average number killed per year per thousand employed is nearly two and one half times as great in Nova Scotia as in Belgium, or are these figures hopelessly complicated by the fact that the number killed per million tons produced is nearly the same in both countries and that the Belgian miner works forty more days in the year and is therefore exposed to danger for that much longer period of time?

Why can the Belgian miner average forty more days in the year than the Nova Scotian, or eighty more than the American? Is it because the Belgian mines are better organized, because they are not shut down by accident so frequently, because of a better adjustment between supply and demand, or what?

Why should the ratio of coal miners killed per thousand employed remain practically stationary in the United States, Belgium, France, Germany and Japan, even on the decrease in New South Wales, while the ratio in Great Britain, India, British Columbia and Nova Scotia is increasing?

When a Montana mining company can effect an annual saving of two million dollars, or the equivalent of fifty cents per ton of ore mined, by the substitution of hydroelectric power for steam (and there is plenty of coal in Montana) is there not something here to ponder over and translate into action?

When the disparity between the deaths by accident to coal miners and to those in other occupations is traceable to defects in our mine workings should we longer depend on voluntary effort?

When an efficiency expert can take a man who has been loading pig iron on to cars at the rate of twelve tons per day and make him load forty-seven tons the next day with less fatigue, should not common sense so swell the ranks of the progressive as to eliminate the economic waste of inefficiency?

Education, not instruction, is the first step in the removal of difficulties like these, but the principle of the greatest good to the greatest number and an economic necessity that will not be denied may demand that where growth is too slow, voluntary effort too half-hearted and too provincial, legal process shall enforce conscription. A coal miner can stoop, so we wait to gouge out the floors of our levels until the roof hits the back of a mule. It is time that tendency gave place to forethought and design in the conduct of our mining operations.

As a constructive program and in addition to those changes in the spirit and ideals of our educational institutions which have been suggested, I venture to enumerate the following, not with the idea that it is complete or has not already been adopted, at least in part, but that it provides a mechanism capable of immediate application and elastic enough to provide for the expansion of the future:

First, the establishment of governmental advisory scientific commissions;

Second, the establishment of governmental "foundations for the advancement of teaching";

Third, the appointment of governmental efficiency experts, consulting master-workers in the business field.

With regard to the *advisory scientific commissions:* The British Advisory Council for Scientific and Industrial Research, the National Research Council of the United States, the Commonwealth Advisory Council on Science and Industry of Australia, and the Advisory Research Council of Canada[1] represent the tendency of the times. The

[1] The expansion of this list to include the research councils of the United States, Australia and Canada will indicate the extent to which the active collabo-

members should have such scientific standing as to inspire confidence and be so free from political, sectional, social, religious and financial bias that the disinterestedness of their public service shall be unquestioned from the start. Such a commission should be ready to consider any and every serious scientific problem referred to it, but the passive function of a disburser of information at the request of others should be the least of its activities. It should watch proposed legislation and should not only inform those interested whether history has proved or scrapped the chosen method of solving the problem, but suggest that method of procedure which the accumulated experience of the world has proved best. Finally, and most important of all, it should initiate reform and suggest legislation. It should be authorized to call in the aid upon special problems, of acknowledged experts, whether they be members of the commission or not.

It should be all-embracive in its scope and national in its institution and effect, a "general staff," if you will, which shall apply to industrial armies the combined wisdom of their experts. It should include the executive heads, or their delegated representatives, of the various scientific bureaus of the government and should be the means of introducing a much-needed cooperation, not only among these organizations, but between them and the scientific world at large. In the procession of the Juggernaut the organized effort of a comparatively small body of men is often necessary to the completion of a task for which the devoted, even frenzied, effort of the multitude has proven incapable. It is evident that the very get-at-ableness of such an organization as has been outlined will insure its frequent utilization, and there can be no doubt as to the value of such a referendum upon proposed legislation.

With regard to the *foundations for the advancement of teaching.* Let us read the concluding statement of the Parliamentary Commission of Great Britain on British charities, an investigation covering more than twenty thousand charities, carried on over a period of nineteen years, and published in forty volumes:

> **Of all objects of charity, the highest education has proved wisest, best and most efficient . . . because in improving higher education all other good causes are most effectually aided.**

Then let us ask ourselves whether governments should not undertake work comparable in many respects with that done by private initiative in the Carnegie Foundation for the Advancement of Teaching in North America. Economic necessity may decrease the number of students in our universities, it will decrease the number who can afford to continue their work past the allotted term. This postgraduate training is essential to the development of the minority intelligence of which

ration of our scientific men has become something more than the tendency it was when the British Council led the way, but no further changes have been made in the text.

we have already spoken and the first expression of the desire of such a foundation to improve the cause of higher education might well take the shape of the establishment of endowed fellowships at those educational institutions competent to equip and direct research. These institutions should be the best in each country and should be selected without fear or favor. The number of fellowships assigned to each should be determined solely on the basis of facilities and the selection of candidates should be so safeguarded as to secure only men of large caliber.

A second mode of expression on the part of the foundation would be the establishment of a considerable number of what might be called traveling fellowships, open to men already in the government employ and to qualified holders of the state-endowed fellowships, for the purpose of resident work in the educational institutions of other countries that shall immediately acquaint their governments with the best thought and the latest developments in the world of science and the arts—an open service of peace instead of the secret service of war—what the Japanese have been doing for years with such telling effect.

The Carnegie Foundation is now providing pensions for the aged and incapacitated professors in the educational institutions of the first rank in Canada and the United States, and such assistance need not therefore be an immediate concern of the governmental foundations in these countries.

In extending its fellowship only to those institutions maintaining certain standards the Carnegie Foundation has been the means of measurably raising the standard of many of the universities of the United States and Canada. In another way, and perhaps it is the farther reaching, it achieves a real effectiveness through the fearless thrusting of offending schools into the pillory of print. Governmental foundations, whatever their authority, might likewise well replace dictation to the spider with education of the fly.

A third, and not the least important, field is that of educational extension, of carrying to the people the information we have kept for those enrolled in institutions.

If the Royal Commission which has been investigating the increase in the cost of living is correct in asserting that one of the main reasons for the evil which it has been investigating is the lack of efficiency in educational systems there is already an abundant field for such foundations as we have outlined. Furthermore, we shall be in possession, during the days that are to come, of the machinery necessary for the handling of any critical situation that may develop in the field of education. We believe that the activities suggested are justified by the present emergency and that their successful operation will produce tangible results. In any case, however, the method of execution must insure cooperation between the foundations and existing educational departments—not so much because this is in the best interests of the scheme

outlined as because such cooperation is essential to the development of higher education.

With regard to the *efficiency expert:* Let us look for a moment at the possible results. A private concern once paid an efficiency expert $150,000 to introduce efficiency in its plant; in the third year under the new régime the resultant saving per year had reached $1,500,000. A foundry in the western part of the United States regularly uses three men to charge a cupola and has continued to do this for twenty years in spite of the fact that in another foundry two men regularly charge a cupola of twice the size, a general inefficiency in the first foundry which enables the second to turn out its finished castings for less than half as much per hundred pounds. The economic pressure of a Panama Canal toll was met by the substitution of oil for coal in the engines of the "Kroonland." The increased expenditure per trip was to be $10,000, the resultant saving per trip, in wages and increased freight carrying capacity, was $35,000. Why did they wait for necessity to compel them to make $25,000 per trip? And why do others now?

The magnitude of the extra charges we may be called upon to meet are incalculable at the present time, and it may be better for the world if these are large enough to dwarf accepted methods of economics, and enforce the fundamental principle of efficiency, of doing things the right way. Indeed, the means at our disposal are so vast that the world may experience a financial recovery that shall be more wonderful than that of France in the early seventies because it will be comparably rapid and more widely beneficial.

We gauge the value of the thing received by the price we pay, and if there were no penalties attached to geographical position, and if there were uniform waste or saving in production, transport, sale and use, this would be true. However, the expert worth having will demand a salary high enough to satisfy us all as to the merit of his recommendations. Our awakening will come in the familiar ring of such suggestions as a fiscal policy that will give to each no more, no less, than he produces, the sharing by the idle of the supertax which we place on the busy, and the efficient use of land at hand and already under cultivation, rather than the hard-earned conquest of remoter areas, in the obviousness of the easy ways which he points out, and in the magnitude of the sums involved. We could do it but we don't; we are going to have to and we need a leader.

Let us remember that that something which will prevent accidents and conserve life, that will prevent waste and conserve resources, that will usher in the spirit rather than the letter of reform, that will make our graduates citizens as well as members of their craft, that will place pure science in the van of industry, that will harness up our brain power, that will replace opportunism with intelligent design in our industrial operations, and that will give us that efficiency which alone spells true economy, is education.

SCIENCE AND MODERN CIVILIZATION[1]

By MAYNARD M. METCALF

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IN the human body there are many important organs each of which is controlled by nerves or internal stimuli acting in opposition to one another. The heart for example has its accelerator nerve fibers which quicken its beat and another set of inhibitor fibers which retard its activity. The balance and interaction of these controlling stimuli regulate the heart action according to the needs of the body. The same principle of control by opposed stimuli prevails in practically all activities of the body. In the arm the extensor and the flexor muscles are opposed and their interaction is necessary to properly directed movement of the arm. The same is true of the leg. The muscles that bend the body toward the right side are opposed by those which would bend it to the left. All the skeletal muscles are thus counterbalanced. In nervous control of the involuntary muscles there is a double set of nervous stimuli acting in opposition to one another. The same is true of nervous direction of secretion in glands. The internal secretions, hormones, are similarly balanced against one another. Tension, stability, accurately directed movement or chemical activity comes in physiological processes through the interaction of opposed directive stimuli. In psychic activities the same principle obtains. One finds direction secured by balancing pain against pleasure and duty against desire.

Phenomena in the inorganic realm show the same principle of control through opposed forces. The stars in their courses are thus held true to their orbits, and, at the other extreme, in the realm of the minute, molecular motion shows control through opposing forces of attraction and repulsion. The principle of direction or control of action through opposing forces or stimuli is widespread in nature.

Human society is similarly affected by opposed tendencies which like the two reins of a horse's harness guide the organism along its path. Socialism and individualism are one such pair of contrasted ideals, both sound, both esential to the guidance of society in its progress.

Our subject suggests a slightly different pair of similarly opposed ideals which may equally truly be regarded as guiding reins of society. I mean what we may call conservatism and radicalism, or traditionalism and experimentism, the binding conserving forces of society on the one

[1] Part of an address delivered before the Chinese Students Alliance at their conference in Oberlin, September 8, 1916.

hand, and the progressive ferments on the other. Perhaps as good phrases as we can find under which to summarize these two groups of influences would be traditionalism[2] and the scientific spirit.

Many men of science are accustomed to decry the spirit of conservatism but all our study of the processes of nature shows us inertia and force in opposition and the inertia is as vitally important as the force.

In human society it is well to have the conservative and the radical forces at work at the same time, but history shows us that the proper balance between them has not always been maintained. During the dark ages of the western world inertia, conservatism, traditionalism, was too dominant and stagnation was the result. During the French Revolution, on the other hand, radicalism ruled without the needed restraints and social results followed which might fairly be called explosive, so ill directed were they. It is possible for two oarsmen to propel a boat by each using his oar without reference to the other, but the progress of the boat, while real, will be very erratic in its course and the goal reached will be very uncertain. Steady progress in a desirable direction comes through properly balanced effort by the two oarsmen at the same time, each in a sense working against the other, yet the two cooperating through their opposition in the progress of the boat.

Two special features of value may be noted in the conservatism of society. To mention the lesser first, the human quality of subservience to custom makes it difficult for a new idea to make its way. It meets opposition and has to prove, often by strenuous effort, its right to prevail, and in this struggle the new conception is itself brought into truer proportions and is perfected.

But far more fundamental is the chief value of conservatism, of social custom. It is the essential foundation for stability, without which there can be no equilibrium and no equable progress. We must be able to know what to count upon in human action, otherwise we can not properly relate our own activities to those of our fellows and to that of society as a whole. If it were a matter of varying chance whether the sun should rise from day to day, if we could not tell confidently in advance whether fire would burn or not, if there were no stable predictable custom in the behavior of things animate and inanimate, chaos would result. And this is just as true of social conditions as it is of all others. Custom is the foundation of all social life and without it there could be no human society.

Custom prevails to differing degrees in the behavior of different

[2] I am making no attempt in this discussion to discriminate between reasonable and unreasonable conservatism, for even unreasonable conservatism serves its useful purpose in society however much hindrance it may also cause. Of course the phrase "scientific spirit" should include a large measure of reasonable conservatism.

organisms. Among the higher plants reaction is almost as predictable as in the inorganic realm. Among the lower forms of animals reaction seems to be determined by the racial or specific character of the organism rather than by its plastic response to conditions newly presented. It does what it is bred in it to do. The response, to use a common though not strictly scientific phraseology, is instinctive rather than intelligent, or we may say it is racial rather than individual. It is only among the highest animals, perhaps only in the case of man himself, that intelligent response involving judgment comes into play.

Similarly in the development of man and of society, custom was at first probably almost wholly dominant, individual independence of the group ideals being a late development. It is still true of most men that they act in accordance with social custom and not upon their own independently formed judgments. Comparatively rarely, indeed, does any person think or act in even a single instance in independence of social convention. In great preponderance, human activity is racial or communal and not individual.

But even as the presence of individuality is a sign among animals of a high place in the realm of being, so among men independence of social convention and the ability to think for one's self, the habit of self-dependent rather than socially subservient action, marks a highly developed man.

We have here a paradox. Society in its evolution comes to produce, more and more, men who are to a degree independent of society, and the percentage of such spiritually independent men in any society is perhaps a fair criterion of the degree of advancement of that society. Among the bees, the hive is everything, each individual being wholly subordinated to the group, and the presence in the hive of uncoordinated members would be disastrous. In human society, on the other hand, the presence of individuals of independent spirit is essential to the vitality of the group. Yet here, as among the bees, overemphasized individualism means the destruction of society. Two qualities, traditionalism and personal independence, two opposing ideals, socialism and individualism, working each against the other are necessary to vitality.

Some years ago, Mr. Harris, then United States commissioner of education, said (I quote from memory) that "the primary function of public education is to persuade the individual to conform to the conventions of society." Contrast this by no means false statement with another by a scholar of old, Paul of Tarsus, who said: "Test all things and hold fast that which proves to be good." The first is the word of the traditionalist and emphasizes the essential quality of social stability. The second is the utterance of the greatest heretic of Christian history and is a fair statement of the spirit of true science: prove all things and hold fast that which is good.

In China traditionalism has ruled for several centuries, and progress has been but slight. Her great need to-day is a liberal infusion of the scientific spirit, to restore the proper balance and secure progress.

But many regard the scientific spirit as dangerous. It is dangerous. It is powerful, it overthrows, it destroys, it starts things moving. But all power is a dangerous weapon, dangerous to the good when wielded by the evilly disposed or the ignorant, dangerous to intrenched evil and incompetence when wielded by the man of high ideal. Huxley was a very striking embodiment of the scientific spirit in the last generation. He was a destructive force, militant against all shams. But he was one of the greatest prophets of God in all his generation, battling manfully, inspiringly, against insincerity and dishonesty wherever found. In the Christian church he found too much respect for dogma and too little regard for truth, and he fought this evil in the church while the church fought him, but among all his Christian opponents was not one who so nobly served the church as did Huxley. The church needed castigation, needed to be held up to itself so clearly that it could see its own subservience to traditionalism, needed to recognize itself a worshiper of the "established" rather than of the true.

Huxley was a very militant example of the man of scientific spirit. One need not always be a fighter. He may be of the milder type and, while devoted to seeking and doing the truth, may let the truth do her own fighting, and she will.

In the orient conservatism has long been too dominant.[3] Society has crystallized, has lost its plasticity and is not flowing forward on its course. There are recent indications that the depths are stirring, and if an explosion is to be avoided there must be a widespread infusion of the solving influence of the scientific spirit of progress.

How can this scientific spirit be introduced? Talking about it accomplishes little. We can not merely say "go to, now, let us all be scientific." The roots of conventionalism have struck too deep into society for any easy change. The fresher spirit can come only by growth, probably at first disappointingly slow. But this growth can be helped to start and to reach a full and rich development.

It can not be helped much by precept, nŏr will the example of other nations be sufficient. The scientific spirit grows by exercise. The doing of the daily tasks of science brings the spirit of science. The introduction of scientific research is the means.

How can this be brought about? How may research be introduced into a nation's life and be fostered? Modern industry is increasingly dependent upon chemistry and physics and the introduction of manufacture will bring them in its train. Engineering is science of the high-

[3] Japan should not be included in this statement.

est order. The introduction of industrialism and its attendant engineering will make very plain the need for scientific training.

Perhaps the most important event, the most hopeful feature in recent Chinese history is the establishment in China of institutions of modern medicine of the strongest, most scientific, type, through the great Rockefeller trust and the cooperation of missionary schools. Medicine touches human lives most intimately and brings relief to our loved ones as well as ourselves. Its appeal is peculiarly strong and vivid. The results of communal hygiene and of scientific resistance to epidemics, as well as the cure of individual maladies, make a striking appeal. Vivid realization of the contrast between modern science and tradition could perhaps nowhere else be so well presented as in medicine. It is a better introduction for the scientific spirit than is even industrialism.

But for China to gain the needed benefit from the introduction of scientific methods in medicine, industry and engineering, for her to get inspiration, to attain through them to the scientific spirit, she must engage in these activities herself. It is not enough to bring in western physicians, to import engineers and factory managers. These will be necessary, but they are not enough. Japan was very wise in one most important particular in introducing western science. She manned her universities and factories at first with western men, but she sent her sons to them to learn, and they did learn. To-day Japan is productive in all fields of scientific research, and her life is becoming as much guided by the scientific spirit as is that of the more progressive of the western nations. It is not enough that western nations should come into China, should develop her mining, her forestry, her agriculture for her, build her railroads and bridges, cure her sick, organize and direct her public health work. China must learn to do these things for herself, and through the doing, reach the real scientific spirit, the spirit of independent judgment of things upon their merits, of proving all things and holding fast that which is good. To this end industrial education, engineering colleges, schools of modern medicine, are needed. Scientific laboratories in colleges and schools and in connection with industrial establishments will teach the ways of science and develop the independent spirit of regard for truth, however contrary to tradition it may prove to be.

This may seem to some a prosaic program, but it will prove far from prosaic. The greatest adventure for a man or a nation is the search for truth and the gaining by faithful service of an unswerving loyalty to truth.

Thus far we have discussed changes that may be expected in the near future, within the next century or half century, changes that are already beginning and which are sure to gather increasing momentum.

It may not be without interest to take a look into the more distant future. What is to be China's ultimate contribution to the world? When she realizes her full development, what will be her share in the world's life?

The biologist has the principles of evolution as the background of all his thinking. He thinks of ethnic and racial problems in terms of centuries and decades of centuries whereas the sociologist thinks more in decades of years. What of the distant future as the evolutionist sees it?

True humankind came into existence apparently about half a million years ago. Of primitive man in Asia we know little, for the paleontology of Asia has been but little studied. Of man in Europe we know more. The earliest human remains in Europe are of a type of man—*Homo neanderthalensis*—now wholly extinct. He was succeeded by *Homo sapiens,* a species which in the course of many thousands of years has given rise to many offshoots which have become more or less distinctly marked subspecies or races. It seems that all races of men now existent belong to this one great species—*Homo sapiens.*

The great diversity of human races has been developed largely through isolation. Mankind spread from their center of origin out over Asia, Africa, Europe and America and the islands of the Pacific, each group coming to occupy a more or less distinct portion of the earth and each group, lacking contact with the other groups, developed independently, evolving into a race more or less divergent from the others. All of man's divergent evolution by which the several races have arisen, took place under conditions of isolation. If the ancestors of Swede and Arab, Saxon and Negro, Greek and Chinaman had all lived together and freely intermarried there would never have been any Swedes, Arabs, Saxons, Greeks or Chinamen, but instead a homogeneous race differing from them all. It is isolation which has allowed the several races of man to develop, to evolve.

But to-day isolation is rapidly being removed. Our means of transportation and of interchange of thought have been so developed, and the world's population is so increasing and spreading into all suitable quarters of the globe, that all men are rapidly becoming neighbors. We are just at the dawn of the day when all men shall live together. And this means not only interchange of cultures, but personal mingling as well. Hereafter no race can develop independently of the rest of mankind. Divergent evolution into races more and more distinct has ceased. We are entering upon a new anthropological period, a period in which divergent evolution has ended and a fusion of the races will begin. Increasing fusion will remove the present rather clearly demarcated racial diversities and the ultimate human species will be one complex race, fused from all those present races which succeed in per-

sisting. With the intermingling of the peoples in their social life, which is increasingly coming the world over, amalgamation could not be prevented, however strongly we might desire to prevent it. The illegitimate unions that would occur, however strong might be prejudice against interracial marriage, would be enough to obliterate in time all race distinction.

In this country there has long been and there is to-day a strong prejudice against intermarriage between the negro and the white man, and those states in which the negroes chiefly live have adopted stringent laws against such intermarriage. Yet in spite of this vigorous prejudice and strict legal enactment the negro in America is rapidly becoming whitened. A few more centuries and any demarcation between negro and white man in this country can not be drawn.

The Jew has been hated in Europe for a thousand years and more. His pride has met his persecutors, and his pride and their hatred have made the strongest bar to intermarriage which one can imagine. We in America can hardly realize the bitterness of the hatred and the social ostracism of the Jew, which has obtained for centuries in Europe and western Asia. Yet in spite of this bar to racial fusion, the strongest humankind could erect, the fusion has gone steadily on. The Syrian Jew is largely a Syrian, the Spanish Jew has many Spanish characteristics. The German Jew has Teuton qualities, and the Russian Jew is largely a Slav. In each country the Jew resembles his Christian or Mohammedan neighbor as much as or more than he resembles his brother Jew in some distant country. Racial prejudice, social ostracism, legal enactment, are all powerless to stop the resistless trend toward racial fusion when diverse races are in actual contact. Amalgamation of all human races which shall survive is inevitable. Whether the thought is agreeable or disagreeable makes no difference in the result. There can be ultimately but one human race and we must fit our thinking to this fact.

From this point of view the questions of chief interest in regard to any race are, first, will it persist and form a part of the ultimate race; and, second, what will be the nature and effect of its contribution to the ultimate race?

Some races apparently will not persist but will succumb and become extinct, as a result of the closer contacts and severer rivalry of advancing civilization. The North American Indian, perhaps the noblest of all savage races, rivalled only by the Maori and the Zulu, seems destined to extinction. So also is the Pueblo Indian of the central regions of this hemisphere. Both these races are stiff and unyielding, too lacking in plasticity to make the necessary readjustments in their character to allow them to fit with their new neighbors into the complex life of the mixed race which is to people America. Indeed both of these

highly developed American native peoples are already approaching extinction.

The aborigines of Australia are going the same road to destruction and the Tasmanians are already extinct. Without ill treatment, but merely through their own lack of adaptability, it seems that some, perhaps many, of the less numerous races must succumb under the new conditions so rapidly approaching. But not all the more primitive races are headed toward extinction. The negro has shown himself very adaptable. He fits into such place as is given him and readily learns the ways of complex society, showing a remarkably high capacity for social education.

It is no easy thing to say which races will persist and which will drop out. We can not safely say the races at present well advanced will continue and that the backward are doomed. The problem is one that has received very little study and it will long form a most enticing puzzle.

If there is any race that seems sure to persist and form a great part of the ultimate race, it is the Chinese. Their great numbers, their remarkable ability to live upon a low economic plane and to thrive, their love of peace, their great stability of personal character, their fine intellectual abilities and their capacity for response to the highest moral conceptions all indicate that the race will persist and will form numerically at least a most important element in the ultimate race.

But what of their influence in guiding and determining the type of civilization under which this ultimate race shall live? Will the Chinese contribute as much intellectually and morally as they will in numbers? This probably depends largely upon their success in wisely guiding their own growth under the new conditions that are approaching.

China has already made a major contribution to human progress. The ancient civilization of China spread to Korea and then to Japan and has profoundly influenced a great portion of mankind. Can she "come back," as the athletes say, and make another great contribution to the social development of the world? No nation has ever yet succeeded in making a second major contribution to the world's progress. Egypt, Assyria, Phoenicia, Greece, Rome, Arabia, Persia have each reached a high degree of culture and have then gone down. The Italian Renaissance, the only apparent exception, was not a revival of old Rome. Much foreign blood had been infused into the old Italian stock till they were an essentially new people.

Thirty years ago Edward Carpenter in a keenly interesting essay—"Civilization, its Cause and Cure"—showed the course of what he called the disease of civilization among those peoples which had reached a high degree of social development and had become dominant each in its turn. This disease has had much the same prodromal stages in all

cases, has culminated in a feverish development and has left the race permanently weakened. No people thus far in the world's history has ever made a good recovery or grown again into world power.

Will China prove an exception? She has once profoundly influenced the world's progress and at that time she reached a degree of culture which in art at least and possibly in some other features is still unsurpassed. Since this, her perihelion, China has gone down, and in later centuries the world has moved on scarcely conscious of China's existence. She has been a fallow field, lying quiet and producing little if any growth. Will she prove like the farmer's fallow field? Has her potential fertility been increasing during these centuries of inactivity? Is she now ready to receive new seed and produce again rich fruit? Who can say? It really seems as if she might be the first of all peoples to show this miracle of regeneration.

Is the disease civilization necessarily and inevitably so disastrous as it has thus far proved for all peoples? May it be that there is an untried cure, an antitoxin that will neutralize its poison? I believe there is such an antidote if we prove able to apply it.

Our knowledge of the principles of breeding, of genetics, is becoming such that we could, if we would, breed a progressively perfecting race. But you know the reply of the small boy who was asked if he couldn't behave for just an hour. He said: "Oh, I could if I would. But I couldn't would." We can breed a stronger and stronger human race if we will, but can we will?

Let us look a moment at this science of genetics and see a little of its phenomena and methods. It is only within the last half generation that we have come to know what it is that is inherited. A man does not inherit a general resemblance to either of his parents or a general blend of the two. He inherits, rather, definite particular qualities and his character is a complex mosaic made up of these many units. Or to be more accurate we should say he receives from his parents, many minute particles of protoplasm each of which is a determiner for a particular unit quality. In general there are two determiners, for each unit quality, one from one parent and the other from the second parent, and the nature of any particular unit quality in the offspring depends upon the interaction of its two determiners, the one received from the male parent, the other from the female parent.

This is not an appropriate occasion for discussing in any detail the phenomena of inheritance. For our present purpose it is sufficient to say that we have learned how so to manipulate organisms in breeding that we can select and combine their unit qualities in almost any manner we choose, thus controlling, predetermining, the nature of the organisms. For example, some years ago there were known two esteemed varieties of the tobacco plant, one with very large leaves and the other

with very numerous leaves. It was determined to combine these two and thus get a variety with both very numerous and very large leaves, and this was easily done. We can control and predetermine the character of animals in the same way. This would be as true of man as of any other animal, if we were free to control human marriage as readily as we determine matings in animal breeding. But, of course, this is not possible, and without such definite and exact control over marriage the process of eugenic improvement in humankind must be very slow.

The subject is one requiring extended and very careful treatment and can not really be included in our thought this morning, though it is the most important thing of all in considering the outlook for the ultimate human race. Let me leave with you just this one suggestion. We can so educate ourselves to higher and higher ideals that not physical beauty nor prowess alone, not intellectual ability nor moral power alone shall seem sufficient, but our standards of manhood and womanhood may be brought to include thorough wholesomeness physically, intellectually and morally, until one deficient in any of these respects shall be recognized as undesirable in marriage. When that time comes the steady pressure of this high ideal of what constitutes attractiveness in marriage will secure eugenic progress. I commend to you for study and careful thought this most keenly interesting subject of eugenics, far too great for any discussion in the few minutes still at our disposal. But in eugenics, I am convinced, lies the future of mankind, and the hope of his escape from the menace of degeneration through the luxury of wealth and ease. This, the newest of the sciences—the science of genetics—will yet show us how to control intelligently the development of mankind in order to reach the fullest realization of their possibilities. This is the science which will be dominant in the ultimate human society.

But this is a long look ahead. Thousands of years will be needed for the perfecting of mankind, even with the powerful aid of eugenic science. The present problem is to set all the nations of the earth upon the road of progress. The vision of the distant heights to be ultimately attained must not make us impatient of the plodding toil along the way. Let the vision rather inspire us to take intelligently the first steps and to continue steadfastly in the path.

The first thing is to introduce and then to cultivate the scientific spirit of search for truth, and to this end let us encourage all the arts and industries that bring us into daily contact with experimental science. Thus by doing the homely tasks of science we shall find the spirit of science entering our souls, this spirit which is the spirit of progress. Let us thus learn fearlessly to test all things, however sacred they may have become through long established custom, and let us with high resolve, hold fast to that which proves itself to be good.

THE NEW SCIENCE OF PLANT SOCIOLOGY

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SOME of the sciences dealing with mankind, such as anthropology, anatomy, physiology and sociology, are pretty closely paralleled by sciences dealing with the vegetable kingdom. Plant sociology (or phytosociology), the science of plant societies, or vegetation, is analogous in many ways to human sociology, the science of human society, or population. Although human sociology deals with only a single species, *Homo sapiens,* it classifies him according to occupations, forms of government, etc. Plant sociology differs in dealing with a multitude of species, but these may be grouped according to structure and adaptations, which are analogous to the qualifications and occupations of men.

A pioneer human society is chiefly made up of hunters, prospectors, cowboys, lumbermen and other resourceful but not highly educated people, while urban society is much more complex, and contains many notables and nobodies, specialists, dependents, idlers and parasites. Likewise a pioneer plant society may consist largely of lichens, mosses and other hardy forms, while in a dense "climax" forest there are tall trees and low herbs; vines and epiphytes, which depend on the trees for support; saprophytes or humus plants, which live on decayed leaves furnished by other plants; and often many parasites as well.

As has been the case with most other sciences, some of the foundations for the one under consideration were laid long before it was thought of as a distinct subject for study. A century and more ago a few observant travelers, even some without botanical training, were describing vegetation correctly though rather superficially; and some of the fundamental principles of the science have been known and used by foresters for several decades. But there is scarcely a hint of the sociological point of view in nineteenth century botanical text-books, classifications of vegetation did not begin to appear in botanical literature until about twenty years ago, and the term plant sociology itself is only about four years old.[1]

A few years ago plant sociology was partly confused with the almost equally new sciences of plant geography and ecology; and such terms as ecological plant geography, meaning the geography of plant associations, and synecology, meaning the relation of such associations to

[1] See *Torreya,* 16: 138, June, 1916. Readers who do not have access to botanical magazines can find a short article on the subject by the writer in the current edition of the New International Encyclopædia.

environment, are occasionally seen now. But geography deals primarily with distribution, ecology with environment, and sociology with association interrelations, three fundamentally distinct points of view. Like every other distinct science, plant sociology has laws peculiar to itself, as will be shown presently.

Probably the most obvious feature of vegetation, the world over, is that it is divisible into groups of more or less homogeneous aspect, such as forests, thickets, meadows, prairies, marshes and deserts. The first step in plant sociology therefore is to classify these vegetation types or associations; just as the early botanists, zoologists and mineralogists were occupied principally with classifying plants, animals and minerals. As a given type of vegetation is commonly correlated with a certain combination of soil, climate and other environmental factors, the first classifications of vegetation were primarily classifications of habitats; and it is indeed difficult to study vegetation without reference to its habitat.

The next step is to analyze each vegetation type. At first, say in the last decade of the nineteenth century, this was done by merely listing the species of plants in each habitat, in botanical or alphabetical or fortuitous order. But it is much more to the point to divide the plants into trees, shrubs, vines, evergreens, perennials, annuals, etc., regardless of their names or taxonomic relationships; though as yet there is little agreement among botanists as to the details of such a classification. It is also very important to determine the relative abundance of the different species or structural categories, for obviously a forest with more pines than oaks, or more shrubs than trees, has a different meaning from one in which the proportions are reversed.[2] For this sort of investigation demography, meaning the study of population, would probably be a better term than sociology, for in it the interrelations of the plants are not specially considered, and the study is static rather than dynamic.

It might be justly said that the demographic study of vegetation has hardly begun, even in the neighborhood of some of the greatest research centers, and there are thousands of square miles in nearly every state and country where we know at present practically nothing of the details of the vegetation, as distinguished from the flora. In the United States the greatest activity in this line has been manifested in and near the upper Mississippi Valley; and nearly all descriptions, photographs and maps of vegetation hitherto published for New England, New York, the south and the far west are the work of men born or trained elsewhere. (The reasons for this state of affairs are somewhat different in each case, and rather complex, and need not be discussed here.) The invention of the half-tone process, about thirty years ago, was a boon to the (then unknown) plant sociologist, for the possibility of making accurate

[2] See 6th Ann. Rep. Fla. Geol. Surv., pp. 175–177 (footnote), 1914.

reproductions of photographs at small expense greatly facilitates the study and comparison of vegetation types.

In dynamic plant sociology, as distinguished from demography, we are concerned among other things with the competition and cooperation between neighboring plants, or the struggle for existence; the rate of establishment and average longevity of the trees or other plants (either collectively or one species at a time), and the annual growth (absolute or relative) of wood, or of all vegetation, per unit area. Such studies, which are analogous to studies of the birth and death rate in human society, have already been pretty highly developed by foresters.

A most interesting phenomenon of plant sociology, which is going on everywhere all the time, but so slowly that it is not easy to observe or to experiment with, and was hardly thought of up to twenty years ago, is succession, which is the gradual replacement of one type of vegetation by another, with or without a concurrent fundamental change in environment.[3] Many botanists have exercised their imaginations by theorizing on this subject, but often with too slender a foundation of facts and therefore without getting definite and convincing results. When quantitative studies of vegetation become more universal, however, the study of succession will be on a more solid basis. One might as well try to discuss the movements of population in the United States without census statistics as to speculate on succession of vegetation without knowing the relative abundance of the species.

Another problem for the plant sociologist is to determine the normal frequency and effect of fire in each type of vegetation. Most people, even foresters, seem to regard forest and prairie fires as mere accidents, to be prevented if possible; but a few ecologists have already studied fire as a normal environmental factor. As fire does not attack scattered or isolated plants, of one species at a time, as a disease or other enemy might, but sweeps through the vegetation when conditions permit, its frequency and intensity depend mostly on the character of the vegetation, and are therefore sociological problems.[4]

The old question of why prairies are treeless, which has been much discussed by geologists, geographers, ecologists, etc., but never satisfactorily answered, is essentially a sociological problem, and perhaps it will be solved when sociological and demographic methods are brought to bear on it. A few of the other problems in plant sociology awaiting solution may be illustrated by the following questions, most of which

[3] The principles of succession have been pretty fully elaborated by Dr. H. C. Cowles in papers published in *The Botanical Gazette* in 1899, 1901 and 1911.

[4] See *Popular Science Monthly*, 85: 338 (footnote), October, 1914. The average forester to-day, probably largely on account of European traditions and teachings, seems to be almost as skeptical about forest fires being part of the natural order of things as the members of the Inquisition three centuries ago were toward Galileo's views about the movements of the earth.

deal with matters easily observed by persons who know nothing of botany. (A trained botanist can easily think of scores of others.)

Why are the tallest trees in a given forest usually all about the same height, regardless of species?

Where are the densest forests in the world? The fastest-growing?

What is the relation between the average distance one can see in a forest and the amount of timber per acre?

In the same climate which takes the most food and water from the soil: forest or prairie?

What keeps evergreen trees from growing in the richest soils, in the eastern United States?

Why are weeds detrimental to crops?

Why are prairie and pine-barren plants all or nearly all perennial?

If the climate became a little colder or warmer, wetter or drier, what plants would become more (or less) abundant?

Most of the sciences have one or more arts based on them, and this is true even of such a new science as plant sociology. Its most important application is in forestry. The forester deals with forests, the highest development of vegetation, in a natural or nearly natural condition, and it is therefore greatly to his advantage to know the laws governing the life of a forest, such as the amount of new wood being produced annually on different soils, the probable effect of cutting out some of the trees or underbrush, the normal frequency of fire, and the influence of insects, grazing animals, and other enemies.

The farmers who cut wild hay from the meadows and marshes of New England and the prairies of the west also have similar problems on a smaller scale, and if they know beforehand just what to expect in the long run from each type of meadow or prairie vegetation so much the better for them.

The art of agriculture has less to do with plant sociology and demography than with ecology. For the growth and yield of cultivated plants depends mainly on the environment and the care given them, but the manner in which they associate is determined artificially and has no particular significance. But weeds come in uninvited, and the effect of their competition is more or less of a sociological problem. And a knowledge of some of the principles of plant sociology is useful to settlers in a new region. The pioneer farmers who clear new land for the plow have long been accustomed to judging its fertility by means of the aspect of the vegetation on it, and if this rather empirical qualitative knowledge could be supplemented by a determination of the annual growth of vegetation much more definite correlations could be made. In a wooded region this would involve some difficulties, but in a prairie region it is as simple as measuring the yield of hay.

Lastly, by a study of the comparatively simple and obvious phe-

nomena of plant sociology one might get some valuable light on the analogous but more recondite problems of human sociology, and a clearer conception of its scope and subdivisions. Plants have the advantage of being fixed in one spot, and they show more delicate responses to environmental conditions and are more easily experimented with than human beings.

Although the opportunities for studying plant sociology are growing less every year with the encroachments of civilization on the forests, marshes and prairies, and some types of vegetation have already disappeared as completely as the Indian tribes of the eastern states, there are still several thousand acres of essentially natural vegetation even within the corporate limits of New York and Chicago, more remote regions are continually being made more accessible by the extension of transportation lines, and some areas of special interest are being set aside as national and state parks or forests, so that the new science is likely to have a healthy growth for some time to come.

MEMORIES OF THE SMITHSONIAN

By Dr. MARCUS BENJAMIN
U. S. NATIONAL MUSEUM

IN Simon Newcomb's "Reminiscences of an Astronomer" he tells of how he visited Washington in 1854 and then "speculated upon the possible object of a queer red sandstone building, which seemed so different from anything else, and heard for the first time of the Smithsonian Institution."

It was not long before Newcomb visited Secretary Henry, who received him "with characteristic urbanity, told me something of his own studies, and suggested that I might find something to do on the Coast Survey." This was the beginning of Newcomb's entrance into the "world of sweetness and light" that culminated in a career and reputation never surpassed by any American man of science.

Thus almost from the completion of the home of this famous institution it began its work "for the increase and diffusion of knowledge among men" which is given in the will of its founder as its particular mission.

The Smithsonian Institution came into existence by the Act passed by Congress and approved by President Polk on August 10, 1846. A building was soon considered necessary and in response to an invitation James Renwick, Jr., of New York City, submitted two designs, one of which in the style of architecture of the last half of the twelfth century, known as the Norman or Lombard was selected.

A site was chosen on the Mall to the west of Seventh Street and about where Tenth Sreet would cross the Park and on May 1, 1847, the corner stone of the new building was laid with imposing ceremonies, including Masonic rites.

The design originally consisted of a main center building two stories high and two wings of a single story connected by intervening ranges, each of the latter having on the north or principal front a cloister with open stone screen. Later the east wing was entirely rebuilt and the connecting range is now four stories high, so that the cloister has disappeared. On the west side the connecting range has been included so as to form part of the structure.

The building, as originally designed, contained provision for objects of natural history, thus at the beginning providing for a museum; archeological and mineralogical cabinet; a chemical laboratory and library; a gallery of art; and lecture rooms.

Two years later, in April, the east wing of the building was ready

for occupancy by the Secretary and his staff, and before the end of the year the west wing was also completed and was being temporarily fitted for occupation as a library.

Let us now return to the man who was the inspiration of the Smithsonian. When Professor Henry came from Princeton to Washington he settled with his family in a pleasant house on the southeast corner of E and Thirteenth Streets, but later the east wing of the Smithsonian building became his permanent home. He was gladly accepted as the foremost among the Washington men of science, and it soon became the pleasant practise of visiting scientists to call and pay their respects to him whenever they were in Washington. Many of these were younger men who came to have a filial affection for him whom they so justly regarded as the Nestor of American science. Two experiences of this character have come to me from friends, both of whom have since been called to fill important places in the scientific world. I venture to include them.

Dr. William McMurtrie, one of the early chemists in the Department of Agriculture, often told me of the happy evenings spent in the Smithsonian, when he was on one side of the table and Professor Henry on the other, discussing papers on chemistry to be used for insertion in the appendix of the Annual Reports. McMurtrie's final years were made less sad by a portrait of Henry that I was able to send him, and when I last saw him he had it framed and hung on the walls of his library among the great men he had known and loved.

When filling the chair of chemistry at the U. S. Naval Academy in Annapolis, Charles E. Munroe, now the senior dean of scientific studies in George Washington University, was always glad to spend a Sunday in Washington, so that he might enjoy the hospitality of the secretary and his family.

Doubtless there were many others; for when there are three young ladies in a family as well as a distinguished father, it becomes difficult to keep the young men away.

Then frequently there came to the Smithsonian Institution members of the Scientific Club, a unique organization that met every Saturday evening, except during the summer months, at the home of some one of its members, and which was essentially the parent of the now famous Cosmos Club of Washington. Among its members was Henry, of whom Hugh McCulloch wrote:

> Professor Henry was thoroughly American in his loyalty to the government; and in his admiration of our republican institutions, but in scientific pursuits he was a citizen of the world.

The other members included: Alexander Dallas Bache, a great-grandson of Benjamin Franklin and for many years superintendent of the Coast Survey; F. A. P. Barnard, then associated with the Coast Survey and later president of Columbia College in New York City; Benjamin N. Craig, of the Army Medical Museum; James M. Gilliss, an

astronomer of reputation who had charge of the Naval Observatory; J. E. Hilgard, then in the service of the Coast Survey, and later its superintendent; General A. A. Humphreys, a famous topographical engineer and later chief of his corps; Jonathan H. Lane, a wonderful mathematician, who lived a life of great usefulness to others but without achieving special distinction; Hugh McCulloch, comptroller of currency, and the secretary of the treasury during Lincoln's administration; General Montgomery C. Meigs, who possessed "vigilance, industry and integrity, with the ability to comprehend large transactions, and master the smallest details" which he demonstrated to a remarkable degree while in charge of the Quartermaster's department during the Civil War; Peter Parker, best known for his knowledge of the Chinese language and for his services to the government in aiding in the establishment of diplomatic relations with China; Titian H. Peale, an artist of recognized ability but associated with the work of the patent office; George C. Schaeffer, "a prodigy of learning" and long librarian of the patent office; and William B. Taylor, the editor of the Smithsonian publications and bibliographer of Henry. McCulloch says of them:

> There was not one who would not have been distinguished in any literary and scientific club in this country, or any other; there was not a money-worshipper or a time-server among them all.

In 1863 the National Academy of Sciences came into existence and its annual meetings have always been held in Washington during April. Bache was its first president and Henry was his successor. Among those named as members in the act of incorporation were Gilliss, Hilgard, Humphreys, Lane and Meigs who were connected with the Scientific Club. The meeting place of the academy was usually in the Smithsonian building, but no meeting was ever complete without the formal reception given by Secretary Henry. And what a splendid galaxy of men these were! There was the gracious and interested Agassiz, the kindly Gray, and the erudite Peirce from Harvard; the two Sillimans, father and son, and Dana, the geologist from Yale; nor should I omit Wolcott Gibbs, the great chemist, an alumnus of Columbia; nor Torrey, the botanist, nor the delightful Newberry, the paleontologist. These and many others graced with their charming personalities these social gatherings in the east wing of the Smithsonian.

The east wing of the Smithsonian Building was assigned to Secretary Henry "and his staff" as a dwelling place, but at that early date the "staff" does not appear to have been very large.

In 1847 Charles C. Jewitt was appointed assistant secretary and librarian, and remained as such until 1855, when he was separated from the institution in consequence of a disagreement of policy with Henry in regard to administration. His retirement has been referred to as representing "the culmination of a struggle between science and literature in which science prevailed."

Spencer Fullerton Baird came to the institution as assistant secretary in 1850 and continued in that capacity until 1878, when, on the death of Henry, he succeeded to the secretaryship, which he then held until his own death in 1887. Baird resided for a time on the corner of B and 10th Streets, south of the institution, but later had his home on the north side of Massachusetts Avenue, between 14th and 15th Streets. He does not appear to have ever lived in the Smithsonian itself, although his offices were for many years over the entrance of the north front of the main building.

Baird will always be remembered on account of his remarkable influence upon young naturalists. John S. Billings, the veteran librarian, said:

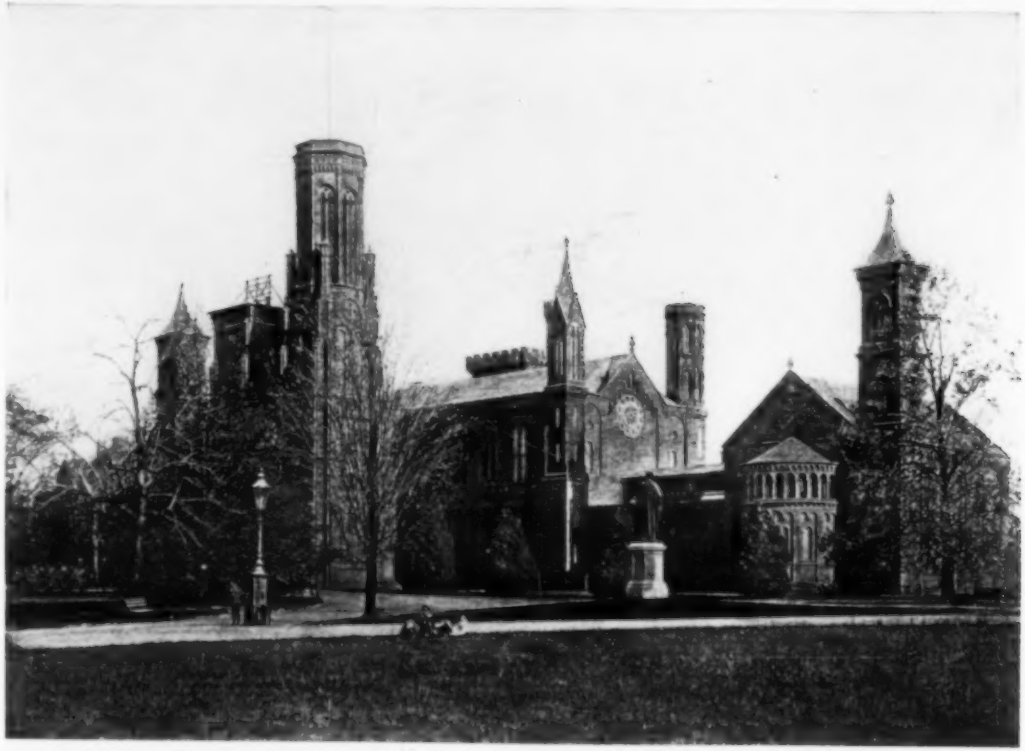
> Such work as was done by Professor Baird in this direction gives a starting point to many observers and investigators in different localities, stimulates further inquiry, and when done on the extensive scale on which he did it, based on the examination and comparison of a large number of specimens from widely different localities, exercises a powerful influence for years to come in lines of exploration, collection and critical research.

Doctor Billings was indeed right; for the influence of Baird is ever with us, and it is seldom that any important volume on natural history is issued by the Smithsonian or the National Museum without reference to this fact. Let me quote in part Robert Ridgway's dedication to Baird which appears in the first volume of his monumental "Birds of North and Middle America," the sixth part of which has just been published.

> Dedicated to the memory of Spencer Fullerton Baird, America's first and best systematic ornithologist, whose guiding principle "What is worth doing is worth doing well" is evident through all his work; who labored for the advancement of science, not for fame.

Mention must be made, even if brief, of William J. Rhees, who was chief clerk during the administration of Henry, Baird and Langley. Yielding, however, to advancing years during the incumbency of the last-named, he became archivist and occupied his closing years in the preparation and publication of the two volumes entitled "Documents Relative to the Origin and History of the Smithsonian Institution." He came to the Institution in 1852 and died in its service fifty-five years later. He was long the senior of us all, and to his wonderful memory I am indebted for many of the reminiscences of the institution that are here given. It is much to be regretted that no time was ever found to place on record those memories which were lost forever when he yielded to that summons from which there is no recall. His deep devotion to the institution he loved so well was evidenced by a bequest from his modest estate.

About the middle of the last century there were two great masters who in this country exerted a tremendous influence upon young men,



THE SMITHSONIAN INSTITUTION.

leading them to the study of natural science. These were Agassiz and Baird. The influence of Agassiz survives in that wonderful assemblage of pupils that included not only his own son Alexander, but also Alphaeus Hyatt, David Starr Jordan, E. S. Morse, A. S. Packard, F. W. Putnam, S. H. Scudder, A. E. Verrill and many others. Baird's in-

JOSEPH HENRY.

fluence was equally potent and many of his students came to the institution and for a time occupied the tower-rooms of the main building so that they might be always near him to profit by his instruction.

The names of many of these young naturalists who came to the Smithsonian have been forgotten, but fortunately some of them may be

recalled by the following stanza, improvised by one of their number, after a hotly contested argument on some disputed point in natural history:

> Into this well of learning dip with spoon of Wood or Horn
> For students Meek and holy silver spoons should treat with scorn.
> If Gabb should have the gift of Gill
> As Gill has gift of Gabb,
> 'Twould show a want of judgment still
> To try to Cope with Meek.

Egleston, the mineralogist; Dall, the conchologist; and Ridgway, the ornithologist, may also be included among those who for a time were tenants of the tower-rooms.

Cope, Dall, Gabb, Gill and Meek became members of the National Academy, which is distinct evidence of the high esteem with which their investigations were regarded by their contemporaries.

Somewhere in his "Life of Lincoln" John Hay tells an amusing story of the tower-dwellers which is not denied by Gill, who was long the only survivor of the war-period.

It appears that one evening when Secretary Henry was busily engaged at the White House with President Lincoln discussing in all probability the scientific features of some one of the many inventions that were submitted to the government authorities either for the improvement of war conditions or for increasing their severity, a visitor appeared who somewhat excitedly insisted on seeing the president at once. He was ushered into the room, and on expressing his desire for a private interview, was assured by Mr. Lincoln that his guest was a loyal Union man. The trouble was soon disclosed; for the stranger broke out into a violent harangue on the treasonable proceedings that had been going on at the Smithsonian Institution. The President promptly replied: "We will have to look into this, and it is fortunate that Professor Henry is here with us to hear your story."

It appeared that every night at a given hour lights appeared in one of the rooms of the South Tower and the shifting of these lights was interpreted as signals by means of which the traitor in the Smithsonian was conveying information to the enemy whose representatives were stationed on the hills in Virginia opposite Washington. The matter was however promptly investigated by Secretary Henry, who was soon able to report that the phenomena of lights was due to the early return of Professor Gill to his room where every evening he devoted his time to the study of the specimens that were assigned to him to report upon.

Gill was the last of the "old guard" and notwithstanding his advancing years he came almost daily to the old building where he gladly gave of his time and knowledge to those who were in search of truth.

His visit to Scotland in 1906 was a great event in his life and he

SPENCER F. BAIRD.

represented some scientific body at the four-hundredth anniversary of the founding of the University of Aberdeen. One Sunday morning when about to enter the local church he was stopped by one of the deacons and asked the strange question: "Are you a Christian?" Not quite prepared for such an interrogation, and perhaps not hearing the words clearly, but realizing that an answer was necessary, he promptly said: "No, I am an American." To which came the response: "Oh, very well, you may go in."

No respectable building of any antiquity, I suppose, can exist without sooner or later having its ghost story. The Smithsonian is no exception to the rule, and for a time tales were in circulation of the white figure that was seen moving rapidly about the halls. Finally, the servants in the secretary's family reported having seen the "ghost" on several occasions at dawn. The matter was soon cleared up; for it was found that a distinguished English scientist who was studying one of the collections was in the habit after taking his cold "tub" of enveloping himself in a sheet and running about in that scanty attire on cold mornings to restore his circulation, a practise which it is almost needless to say he promptly discontinued when his attention was called to the unfortunate notoriety that he was giving to the building.

Doubtless because of the skeletons and bones of strange animals that claimed the attention of some of the scientists who reported on the specimens that came to the Smithsonian from the early trans-continental surveys the institution came to be regarded as haunted. This was especially true in the case with the colored people, whose superstitious

natures made them so fearful of the innocent building that they could not be induced to pass the door after sundown.

It is said that on one occasion a colored man who was seeking employment was hired by an official of the Smithsonian and on being told to report to the institution, became so frightened that he ran away and could not be found for two weeks.

The main portion of the Smithsonian building was two stories high, each of which contained a large hall. The one on the lower story was not occupied at first, but it was here that as early as 1856 there was on daily exhibition a large map showing the condition of the weather over a considerable portion of the United States. Every morning reports were received by telegraph, telling of the changes that had occurred and these were then indicated on the map by pieces of card-board of different colors serving to denote different conditions of the weather as to clearness, cloudiness, rain or snow. It is interesting to add that Professor Henry said:

> This map is not only of interest to visitors in exhibiting the kind of weather which their friends are experiencing, but is also of importance in determining at a glance the probable changes which may soon be expected.

Thus it was that the Smithsonian Institution was the first in the world to organize a comprehensive system of telegraphic meteorology and gave to the world as Cleveland Abbe describes it "that most beneficent natural application of modern science, the storm warnings." It was indeed the beginning of the Weather Bureau service.

The civil war interrupted the continuance of this service and the hall was assigned to the exhibition

THEO. GILL.

SAMUEL P. LANGLEY.

of museum specimens, principally the bird collections. With the removal of these to the newer building of the National Museum, part of the ever-growing library has been installed there.

On the upper floor was the large lecture room, capable of holding two thousand persons and there every winter courses of popular scientific lectures were delivered by masters in their specialties. To them the public of Washington was cordially invited and gladly came. It was at one of these, presided over by the venerable George Washington Parke Custis, that Otis T. Mason received his first inspiration to devote his attention to American anthropology, on which subject he afterwards became a recognized authority, and at the time of his death in 1908 was head curator of anthropology in the National Museum. This hall was given up later to the exhibition of the collections in prehistoric archeology and now contains the enormous collection of plants that constitutes the National Herbarium.

The west wing of the Smithsonian has often been called the chapel, owing perhaps to the square tower and apse that are on the north side. It was originally used as a library, but the increasing volume of books

CHARLES D. WALCOTT.

that poured in soon made other arrangements necessary. For a time the collections of marine invertebrates were installed there, but since these collections were transferred to the larger building it has not been permanently occupied.

From the fact that Greenough's statue of Washington that so long stood exposed to the elements on the east front of the capitol has found a resting place in this wing its use as a gallery for sculpture has been suggested.

During the summer before last it served a sacred purpose and so was consecrated anew by loving and competent hands to the restoration of the original Star-spangled Banner that floated over Fort McHenry just a century ago, and inspired the immortal words of Francis Scott Key.

After the death of Henry the offices of administration were grouped

in the east wing and business became the dominant feature of that end of the building. Thereafter functions were usually given in the larger buildings of the National Museum. It is, however, of interest to remember that the workshops in which Secretary Langley constructed the machinery for the aerodrome with which he showed the practicability of aerial navigation were on the upper floor. That the trial of his machine was not altogether a success broke the heart of Langley, and he never was the same after that unfortunate experience.

John A. Brashear, a life-long friend, tells the following pathetic account of his last visit to Langley. He says:

> I can not forget the last half-hour I spent in his office in the Smithsonian Institution, where I had so many pleasant talks with him in past years. He showed me the little piece of apparatus that had broken, deflecting the aerodrome into the Potomac, whereas it should have sailed up into the air. With a sad heart he turned to me and with trembling voice said, "Mr. Brashear, this has wrecked my hopes forever. My life work is a failure." I did all in my power to cheer and comfort him, but it was too late.

The world failed at first to appreciate the value of Langley's demonstration, and he died without realizing the enormous value of his great contribution to science. During the summer of 1914 Glenn H. Curtiss has demonstrated on Lake Keuka in New York with Langley's original machine its absolute power of flying, thus establishing beyond every possible dispute that Langley's aerodrome represented "a clear triumph for pure inductive science." He was the first to demonstrate that powerful machines heavier than the air itself could be built to navigate the air.

The present secretary, Charles D. Walcott, now occupies the rooms of Langley's workshop with his laboratory, and there he devotes the time that he can spare from his administrative duties to the study of the Cambrian fauna, finding feet for wandering trilobites and furnishing eyes to those curious brachiopods that swam in the seas of that prehistoric long ago.

THE PROGRESS OF SCIENCE

BOOK OF THE OPENING OF THE RICE INSTITUTE

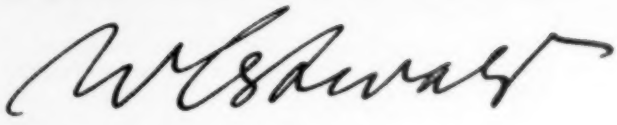
THERE have been issued from the De Vinne Press three sumptuous volumes commemorating the academic festival held in celebration of the formal opening of the Rice Institute, which occurred on the tenth and twelfth of October, 1912. There has already been given in this journal some account of the institute founded in Houston, Texas, by William R. Rice, and dedicated by him to the advancement of letters, science and art. The volumes which have now been published give a detailed account of the opening of the institute and the text of the inaugural lectures given by distinguished foreign men of science. The volumes are by special permission inscribed to the "thirteenth president of Princeton University and the twenty-eighth president of the United States." The ceremonials which they describe were among the last of international gatherings.

In his dedicatory address, Dr. Edgar O. Lovett, the president of the institute, gives a full account of its foundation and its objects. During his lifetime Mr. Rice gave considerable sums to a board of trustees organized to administer the foundation and made the new foundation his residuary legatee. After a long litigation following his death, the institution was in possession of an estate whose present value is estimated at not less than ten million dollars. The institute secured a campus of 300 acres three miles from the center of the city, and a general architectural plan designed by Mr. R. A. Cram was accepted by the board in the spring of 1910. The Rice Institute plans to be a university of the highest standing, including in its scope science, letters and art. It is said that at the outset art is to be recognized by the architecture and physical setting of the buildings. The teaching and research are divided into three divisions, science, humanity and technology, and it is the aim of the institution to achieve its widest claims to distinction in those regions of inquiry and investigation where the methods of modern science are more directly applicable. There are erected in the building three marble tablets to letters, art and science, the last bearing the profile of Isaac Newton and Job's anticipation of the method of scientific inquiry, "Speak to the earth and it shall teach thee!" On the granite columns of the cloister appear the heads of sixteen leaders, of whom ten are in science. They are: Medicine, Pasteur; Engineering, De Lesseps; Mathematics, Lie; Physics, Kelvin; Chemistry, Mendeleef; Biology, Darwin; Electric Oscillations, Hertz; Aerodynamics, Langley; Radioactivity, Curie; Eugenics, Galton.

The main part of the volumes is taken up by the addresses of twelve distinguished foreign delegates, each of whom gave from one to four lectures. The death of Henri Poincaré prevented his giving the promised lectures on the philosophy of science; a memoir on his life and work was presented by Professor Volterra. Excellent portraits are given of the lecturers, several of which are here reproduced, and tablets were erected in commemoration of their presence at the opening exercises. The inscriptions on the tablets for the seven scientific men are as follows:

Professor Emile Borel, of Paris, France: director of scientific studies at the Ecole Normale Supérieure; Editor-in-chief of *La Revue du Mois;* professor of the theory of functions at the University of Paris; successful in the discharge of exacting duties as admin-

Hugo de Vries



istrator, educator and editor, his studies in mathematical analysis worthily maintain the standards of scientific work established by the historic line of French analysts extending from Lagrange and Laplace to Hermite and Poincaré.

Professor Hugo de Vries, of Amsterdam, Holland: director of the Hortus Botanicus and professor of the anatomy and physiology of plants in the University of Amsterdam; a careful observer and patient investigator of the phenomena of growth and change in living things, whose studies and experiments of a quarter of a century have resulted in capital contributions to the theories of heredity and the origin of species.

Privy Councilor Professor Wilhelm Ostwald, of Gross-Bothen, Germany: late professor of chemistry in the University of Leipsic; Nobel Laureate in Chemistry, 1909; a versatile man of science whose interests and activities range from art through letters into metaphysics, he is justly celebrated as one of the founders of physical chemistry and equally well known as the chief propagandist of a new natural philosophy based on the theories of energetics.

The late Professor Henri Poincaré, of Paris, France: Member of the French Academy; Commander of the Legion of Honor; professor of mathematics and astronomy at the University of Paris; distinguished for discoveries of far-reaching significance in pure mathematics, celestial mechanics and mathematical physics, a varied intellectual activity of extraordinary fertility has secured for him a place of eminence in letters, in science and in philosophy.

Professor Sir William Ramsay, K.C.B., of London, England: late professor of chemistry at University College, London; Nobel Laureate in Chemistry, 1904; president of the Seventh International Congress of Applied Chemistry; a facile experimenter of boldness and ingenuity, who has devised new theories and revived outworn ones in a series of remarkable achievements which of themselves constitute an epoch in the history of the chemical elements and a permanent chapter in the annals of science.

Professor Carl Størmer, of Christiania, Norway: Member of the Norwegian Academy of Sciences; associate editor of the *Acta Mathematica;* professor of pure mathematics in the University of Christiania; professorial successor of the illustrious Norse geometer, Marius Sophus Lie, and himself a master of the methods of reckoning who has drawn from the equations of mechanics a new theory of terrestrial magnetism revealing new explanations of the lights of the northern skies and kindred manifestations in the solar system.

Professor Vito Volterra, of Rome, Italy: life senator of the Italian Kingdom; dean of the faculty of science and professor of mathematical physics and celestial mechanics in the University of Rome; recently lecturer in the universities of Paris and Stockholm; an analyst of rare skill whose theories have found manifold applications both in pure and in applied science, he has served his country even more directly as an able organizer of educational and scientific undertakings national in scope and international in influence.

IMPORTED AND NATIVE WOODS USED FOR DYE MATERIALS

THE New York State College of Forestry at Syracuse is investigating the importation and use of foreign dye woods and the recent use of certain native species for dye wood purposes. The college is receiving many inquiries about the use of various woods for dye purposes and the investigation is being carried out to meet these inquiries.

The English blockade of all German exports as a phase of the great war, has prevented the importation of the well-known German aniline dyes. To meet this situation, the importation of foreign dye woods has been greatly stimulated. Along with this use of foreign dye woods is the increased use of the native osage orange for native colors.

Röntgen

In 1915 over 68,000 tons of dye woods valued at over $1,000,000, were imported into this country. In the year 1916 it is estimated that there will be a large increase in both quantity and value. Logwood is the most widely used dye wood that is brought into the country. During the year 1915, of the total amount it made up over 55,000 tons valued at $742,000. The pieces of wood as imported vary in diameter from 4 inches up to 3 feet or more and about 20 to 25 pieces on the average make a ton. A good share of this wood comes from Mexico. It is estimated that there are over 1,000 tons of logwood on the piers in New York harbor at the present time. In fact there has been such a demand for foreign dye woods that it has tended to stimulate production resulting in considerable speculation.

Owing to the tremendous demand for shipping facilities to carry war munitions, food and other supplies to the warring nations in Europe, the prices for transporting dye wood have been the principal cause for the great increase in the prices for these dye wood materials. For example, logwood before the war was normally sold for about $19 per long ton. The present price is around $50 per long ton. Before the war fustic brought a price of $19 per long ton and now brings $40. Lima or Brazil formerly brought $25 and now is worth $40. The price of osage orange has remained about the same, namely $15 per long ton delivered. In fact all of these prices are given as delivered on the docks in New York harbor. The transportation charges are commonly quoted at from $22 to $28 a ton from West Indian and Mexican ports to the Atlantic seaboard.

Beside logwood, the principal woods are fustic, Lima wood or Brazil wood and a few other woods of lesser importance. Osage orange, which is found chiefly in eastern Oklahoma, Kansas, Arkansas and Missouri, as well as throughout the lower Mississippi valley, is coming into considerable prominence in the dye wood trade.

Dye woods have been brought to this country for the past 200 years. One New York company has been importing them for 115 years. Logwood which probably makes up 80 per cent. of all the wood used for dye purposes, is used for blue and black colors. Fustic and osage orange are used for the yellows and the Brazil wood is used for red. For other colors blends between these are used. The dye wood extract manufacturers require that the wood be completely stripped of all bark and sap wood. In fact the heart wood of the trees is the only portion that contains sufficient dyeing material to justify the expensive transportation charges involved. The trade generally considers that the outlook for osage orange is not particularly bright, for the reason that there is a sufficiently large supply of other and better dyeing material available.

FIGHTING AUSTRALIAN APHIDS WITH MAINE FLIES

An interesting situation in international entomology has recently developed with reference to the modern practise of introducing, from one country to another, an insect control of an insect pest. The spectacular success of the Australian lady-beetle against the fluted scale of citrus fruits in California; the slower, more complex but effective work of imported parasitic and predaceous enemies against the brown-tail and gypsy moths in New England; and other experiments of this nature varying in importance; are already matters of economic history.

Up to this time few, if any, attempts have been made, in this connection, to distribute the Syrphidæ, a family of flies (Diptera) many of which are, in their larval stages, predaceous upon aphids. It has been well known, of course, that this habit is of real economic importance, but it has apparently been customary to relegate these flies to a position of second importance in this field of useful endeavor and to confer first honors to the lady-beetles and parasitic Hymenoptera.

V. Volterra

Observations of some ten or twelve years in Maine, however, indicated strongly that the syrphid larvæ are, in that locality, the most efficient natural enemies of the aphids. In accordance, therefore, with the entomological policy of the Maine Agricultural Experiment Station to solicit the cooperation of specialists for problems of prime importance, Professor C. L. Metcalf was invited to study the Syrphidæ of that state with particular reference to their larval habits.

Significant data were thus secured concerning which species of syrphids feed upon a given species of aphid. The publication, in bulletin form, of this and related information included the statement that a certain syrphid, *Pipiza pisticoides*, plays in the vicinity of Orono a rôle of first importance as a natural enemy of the woolly aphid of the apple. The larvæ feed so abundantly that the above ground colonies of this pest are well nigh exterminated by late summer.

Following upon this announcement a request came from Perth, Western Australia, for an importation of these flies in consideration of the fact that the woolly aphid is the most serious apple pest in that state. Accordingly, plans are underway for the shipment of *Pipiza pisticoides* and possibly other syrphids which accept the same diet.

It is never safe to predict results in an experiment of this sort, but the indications are in favor of a successful outcome. In which case the nice exchange of international courtesies—apples in Australia for oranges in America through benefit by insects—is of scientific as well as agricultural interest.

SCIENTIFIC ITEMS

We record with regret the death of Professor Emil von Behring, of the University of Marburg, discoverer of diphtheria antitoxin; of Professor J. G. Darboux, permanent secretary of the Paris Academy of Sciences and professor of mathematics at the Sorbonne; of George Massee, for many years head of the cryptogamic department of the Herbarium of the Kew Gardens, distinguished for his work in mycology; of M. Jules Courmont, professor of hygiene at Lyons; of G. Paladino, professor of histology and general physiology at the University of Naples, senator of the realm, and of General J. A. L. Bassot, the distinguished French geodesist.

Dr. Alexander Graham Bell, inventor of the telephone, was awarded the Civic Forum Gold Medal for distinguished public service in New York on March 21. The presentation address was made by Dr. John H. Finley, state commissioner of education. Dr. Bell is the third recipient of the medal. It was awarded to Major General George W. Goethals in 1914, and to Thomas A. Edison in 1915.

Sir J. J. Thomson, Cavendish professor of physics at the University of Cambridge and president of the Royal Society, Sir David Prain, director of Kew Botanical Gardens, and Sir George Beilby, head of the Royal Technical College of Glasgow, have been elected trustees of the Carnegie Trust for Scottish Universities.

Mrs. Stephen V. Harkness has given to Yale University funds to erect dormitories for the use of students of the college in the form of one or more quadrangles. It is said that the value of Mrs. Harkness's gift may exceed five million dollars.

It is reported that the Rockefeller Institute for Medical Research has appropriated $200,000 for the establishment of a hospital to be used for the instruction of surgeons in the Carrel-Dakin treatment of the wounded. It is expected that Dr. Alexis Carrel will be granted a leave of absence from France to return to New York and assume supervision of the work.